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Volume VIII

EXPLANATORY NOTES
for
DEPARTMENT OF AGRICULTURE
BUDGET ESTIMATES

Fiscal Year

1946

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AGRICULTURAL RESEARCH ADMINISTRATION
OFFICE OF ADMINISTRATOR

(a) Salaries and Expenses

Appropriation Act, 1945\$136,656
Proposed consolidations in 1946 estimates by transfer from:
"Beltsville Research Center" +130,760
"Salaries and expenses, plant industry, soils, and agri-
cultural engineering, Agricultural Research Administration,"
plant industry experiment farm + 56,976
Total available, 1945 324,392
Budget estimate, 1946 285,200
Change for 1946:
Overtime decrease ... -42,155
Increase + 2,963 - 39,192

PROJECT STATEMENT

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
1. Administration and direc- tion of the Agricultural Research Administration	104,636	121,400	121,400	- -
2. Supervision of mainte- nance, operation, and furnishing of facilities and services at the Agri- cultural Research Center	145,817	160,837	163,800	+ 2,963 (1)
3. Overtime costs	36,707	42,155	- -	-42,155
Unobligated balance	2,249	- -	- -	- -
Total available	289,409	324,392	285,200	-39,192
Transferred in 1945 estimates from:				
"Special research fund, Department of Agriculture"	-22,589	- -	- -	
"Salaries and expenses, agricultural and industrial chemistry, Agricultural Research Administration,"				
regional research labora- tories	-27,895	- -	- -	
Total estimate or appro- priation (1944 and 1945 adjusted for compara- bility)	238,925	324,392	285,200	

Note: The 1946 Estimate recommends the consolidation with this appropriation of the items "Beltsville Research Center" and "Plant Industry Experiment Farm." In the past, these two separate items have financed certain facilities and services necessary for the operation of research activities of the bureaus of the Agricultural Research Administration conducted in the vicinity of Beltsville, Maryland. It is recommended, therefore, that the service fund affecting all bureaus in the Administration be included in the appropriation for the Office of Administrator.

INCREASES OR DECREASES

The net decrease of \$39,192 in this item for 1946 consists of the \$42,155 decrease for overtime, and the following:

(1) An increase of \$2,963 for maintenance and general care of grounds in the immediate vicinity of buildings at the Agricultural Research Center.

With existing funds it has not been possible to maintain adequately the grounds immediately surrounding several buildings at the Agricultural Research Center. The shrubbery and lawns in certain areas suffer from lack of care, which detracts from the appearance of the buildings and creates unfavorable impressions. The increase is requested to provide funds for the necessary labor to correct this situation.

CHANGES IN LANGUAGE

The estimates include proposed changes in the language of this item as follows: (new language underscored, deleted matter enclosed with brackets):

Salaries and expenses: For necessary salaries and expenses of the Office of Administrator, including the salary of the Administrator at \$9,200 per annum, and personal services in the District of Columbia and elsewhere, [\$136,656.] and for necessary expenses in connection with the

[BELTSVILLE RESEARCH CENTER]

[For general administrative purposes, including] maintenance, operation, [construction or alteration of necessary buildings at a cost of not to exceed \$7,500, repairs, and other expenses, \$130,760:] and furnishing of facilities and services at the Agricultural Research Center, \$285,200: Provided, That the appropriation current at the time services are rendered may be reimbursed (by advance credits or reimbursements based on estimated or actual charges) from applicable appropriations, to cover the charges, including handling and other related services, for equipment rentals (including depreciation, maintenance, and repairs); for services, supplies, equipment and materials furnished, stores of which may be maintained at the Center, and for building construction, alteration, and repair performed by the Center in carrying out the purposes of such applicable appropriations and the applicable appropriations may also be charged their proportionate share of the necessary general expenses of the Center not covered by this appropriation: Provided further, That the several appropriations of the Agricultural Research Administration shall be available for the construction, alteration, and repair of buildings and improvements: Provided, however, that unless otherwise provided, the cost of constructing any one building (excepting headhouses connecting greenhouses) shall not exceed \$5,000 and the cost of altering any one building during the fiscal year shall not exceed \$2,500 or 2 per centum of the cost of the building as certified by the Research Administrator, whichever is greater.

The first change in language involves the merging of the appropriation for the Beltsville Research Center with the Office of Administrator so that this service item affecting all bureaus of the Administration will be financed from the appropriation to the Office of Administrator. The changes recommended in the existing language of the Beltsville Research Center item are (1) the elimination of the separate provision for construction and alteration of buildings, since a general limitation applicable to all agencies of the Agricultural Research Administration is proposed in the language of the Office of Administrator, Agricultural Research Administration; (2) changing the reference to the Center in the Act from the "Beltsville Research Center" to the "Agricultural Research Center" to indicate more clearly its nature; and (3) editorial changes necessary in consolidating the present language with the appropriation item for the Office of Administrator.

The second change in language is to provide a general clause covering construction and alteration of buildings, replacing various such provisions now carried in a number of appropriations to bureaus in the Agricultural Research Administration. The several existing provisions vary considerably in form and in the amount of the limitation. To establish uniformity and avoid unnecessary repetition of language it is deemed desirable to have language in one place in the Bill, replacing the several separate provisions, which would provide appropriate authority applicable to all appropriations of the Agricultural Research Administration. The general provision recommended places a limitation of \$5,000 on the construction of any one building. This amount is proposed to cover the needs of erecting comparatively small buildings necessary in carrying out the programs of the Administration. The buildings involved would include sheds, barns, storage buildings and structures of similar size to house experimental animals, inflammable materials, equipment, etc. The limitation on alteration of buildings proposed is \$2,500 or two per centum of the cost of the building, whichever is greater. The limitation of \$2,500 would apply to all buildings costing not in excess of \$125,000 and the limitation of two per centum would apply to buildings of greater value. This authority covers alterations that may be required to adapt existing facilities to the changing needs of the research program as they develop and to avoid, in some cases, the erection of new buildings.

The following tabulation summarizes the existing provisions and indicates the maximum amounts permitted for construction and alteration of any one building.

Present Limitations on Construction and
Alteration of Buildings

Appropriation Item	Summary of Present Limitations
Office of Experiment Stations:	
Federal Experiment Station, Puerto Rico	\$3,000 for <u>all</u> construction and alterations
Bureau of Animal Industry:	
Animal Husbandry	\$5,000 for the erection or alteration of any one building
Diseases of Animals	\$5,000 for the erection or alteration of any one building
Bureau of Dairy Industry	\$10,000 for <u>all</u> construction and alterations

Present Limitations on Construction and
Alteration of Buildings - Continued

Appropriation Item	Summary of Present Limitations
Bureau of Plant Industry, Soils, and Agricultural Engineering	\$2,500 for construction of any one building; \$500 or 2 percent of the cost of a building, whichever is greater, for alterations but not exceeding \$2,500 for any one building
Bureau of Entomology and Plant Quarantine	\$1,500 for construction or alteration of any building; total expended not to exceed \$7,000
Bureau of Agricultural and Industrial Chemistry	\$7,500 for construction of any one building; \$500 or 2 percent of the cost of a building, whichever is greater, for alterations
Beltsville Research Center	\$7,500 for <u>all</u> construction and alterations

WORK UNDER THIS APPROPRIATION

The Office of Administrator, Agricultural Research Administration, provides for direction and supervision of the Administration which comprises the Bureau of Animal Industry; Bureau of Dairy Industry; Bureau of Plant Industry, Soils, and Agricultural Engineering; Bureau of Entomology and Plant Quarantine; Bureau of Agricultural and Industrial Chemistry; Bureau of Human Nutrition and Home Economics; and Office of Experiment Stations. The Administrator is also responsible for general administration of the Special Research Fund and general supervision of the Agricultural Research Center.

Functions: The Office of Administrator plans, develops, coordinates, and directs the scientific research program of the Agricultural Research Administration to assure the most effective utilization of personnel and facilities; relates the Department's research program with those going forward in private industry and in other Governmental agencies; and determines research objectives in the light of the changing needs of agriculture and of the Nation for foods and fiber.

Examples of Progress and Current Program:

Administration and direction of the Agricultural Research Administration: The Office of Administrator has continued to place special emphasis upon direction and coordination of research to meet emergency problems. Working relationships are accordingly maintained with the war agencies. At the same time, preliminary attention is being given to the necessary redirection of the research program as adjustments in agriculture may require.

To assure integration and coordination of all phases of the research of the Administration, each proposed individual project is submitted for consideration and approval by the Office of Administrator before the work is undertaken.

All memoranda of understanding and cooperative agreements covering research which is cooperative with State agricultural experiment stations or other agencies are reviewed and approved, except when broad Department policies are involved which require approval by the Secretary.

Efforts have been directed toward simplifying and improving administrative operations affecting research. A start has been made on the reporting of individual results in research in a readily available, readable form. Plans are under way for the preparation of popular publications on different crops and kinds of livestock, each publication to sum up the recent scientific developments in that field for the information of farmers and the public. Thus each publication will be a joint undertaking of various research agencies. Through the Office of Administrator, the research agencies cooperate in many other ways to improve the reporting of scientific developments.

The Office of Administrator has cooperated with the Office of the Solicitor in the formulation of a manual on the procedures and policies applying to patents for the guidance of Department research workers whose investigations may possibly result in materials, equipment or techniques which should be patented in the public interest.

Supervision of maintenance, operation and furnishing of facilities and services at the Agricultural Research Center: The funds provided under this project are utilized primarily for the development and maintenance of general service and administrative functions at the Agricultural Research Center such as water, fire protection, sewage disposal, power distribution, telephone, roads, granary and coal handling facilities, guard service, a mechanical shop, a farm operating unit and related operations.

The granary purchased and processed 3,639 tons of livestock and poultry feed. The coal handling facilities purchased and distributed 29,536 tons of coal. The sewage disposal plant treated 130,372,000 gallons of sewage. There were 6,509,250 kilowatt hours of electrical energy purchased and distributed over Center-owned lines; 165,000,000 gallons of water were supplied from the Center's eight wells. A central switchboard was maintained with an average of 330 main stations and extensions. Around-the-clock guard service was operated. Mail service to and from Washington and a messenger service to each unit on the farm was in operation each workday. The mechanical shop received and completed 4,560 requests for service.

Maintenance of roads will be improved with the increase in funds provided for this purpose in the 1945 Act.

(b) Special Research Fund, Department of Agriculture
(Allotment to Office of Administrator)

This budget schedule covers obligations under an allotment for the Special Research Fund regional laboratory to conduct research into the relation of soils to plant, animal, and human nutrition, a project which is placed under

the direct supervision of the Agricultural Research Administrator, since the subject matter is not exclusively within the functions of any one constituent Bureau.

(c) Emergency Fund for the President, National Defense
(Transfer to Office of Administrator)

This budget schedule covers obligations for expenses of the Office of Administrator in connection with certain emergency plant disease and insect pest prevention.

(d) Working Funds (Office of Administrator)

This budget schedule covers obligations under advances to the Office of Administrator, pursuant to section 601 of the Economy Act of June 30, 1932, for services performed for agencies as indicated in the following statement of obligations under supplemental funds.

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS
[1944 and 1945 figures include overtime costs]

Item	Obligations 1944	Estimated obligations, 1945	Estimated obligations, 1946
<u>Special Research Fund, Department</u>			
<u>of Agriculture: For laboratory</u>			
for research into relation of			
soils to plant, animal and			
human nutrition	\$102,132	\$108,390	\$ 96,600
<u>Emergency Fund for the President,</u>			
<u>National Defense: For general</u>			
administrative expenses con-			
nected with certain emergency			
plant disease and insect pest			
prevention	3,026	1,974	- -
<u>Working Funds, (Office of Admin-</u>			
<u>istrator, Agricultural Research</u>			
<u>Administration) Advances from:</u>			
<u>War Production Board: For</u>			
directing and coordinating			
investigations in food com-			
pression, packaging dehy-			
drated compressed food pro-			
ducts, and related studies	8,041	1,500	- -
<u>Federal Works Agency: Emer-</u>			
gency guards at the central			
guard office, Agricultural			
Research Center	4,677	5,475	- -
Total, Working Funds ...	12,718	6,975	- -

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS - Continued

Item	Obligations 1944	Estimated obligations, 1945	Estimated obligations, 1946
Cooperation with the American Republics (Transfer from State 1/			
Intern training for students			
in agricultural science with-			
in the Agricultural Research			
Administration	- -	18,800	- -
Total, Obligations Under Supple-			
mental Funds	117,876	136,139	96,600

1/ The budget schedule relating to this project appears in the State Department section of the Budget, page 596.

PASSENGER-CARRYING VEHICLES

The estimate for the purchase of passenger-carrying vehicles for the Office of Administrator, Agricultural Research Administration, contemplates an increase of \$800, (\$800 in 1946, no estimate for 1945) in expenditures for this purpose. The total estimated expenditure of \$2,350 will permit (1) the operation and maintenance of 10 vehicles and (2) the replacement of 1 vehicle at a net cost of \$800 when the estimated exchange allowance is taken into account. No funds are requested for the purchase of additional vehicles.

The cars involved are necessary for the conduct of operations at the Agricultural Research Center which covers an area embracing 11,700 acres.

In normal times, when new cars are readily available, experience has shown that it would be more economical to trade in about 25 percent of the total fleet, so as to avoid exceeding an average age of about four years. In view of the emergency situation, however, it is proposed to exchange only one automobile which will be 3 years old and will have been driven about 45,000 miles when turned in.

PENALTY MAIL
Section 2, Public Law 364, 78th Congress
(Allotment to Office of Administrator,
Agricultural Research Administration)

	<u>Category 1</u>	<u>Category 2</u>	<u>Total</u>
1945	\$15	\$411	\$426
1946	15	411	426
Change	- -	- -	- -

Category 1. Consists of bulletins and circulars reporting the results of research mailed in response to requests for information on research problems which are received by the Office of Administrator.

Category 2. Consists of administrative correspondence necessary for (a) carrying on the work of the Office of Administrator, involving the administration and direction of the Agricultural Research Administration which comprises the Bureau of Animal Industry; Bureau of Dairy Industry; Bureau of Plant Industry, Soils and Agricultural Engineering; Bureau of Entomology and Plant Quarantine; Bureau of Agricultural and Industrial Chemistry; Bureau of Human Nutrition and Home Economics, and the Office of Experiment Stations; (b) conducting administrative operations at the Agricultural Research Center, particularly the mailing of business documents, such as purchase orders, contracts, and vouchers, in connection with the services and supply activities performed by the Center; and (c) conducting the research program of the Plant, Soil, and Nutrition Laboratory at Ithaca, New York.

SPECIAL RESEARCH FUND, DEPARTMENT OF AGRICULTURE

Appropriation Act, 1945	\$1,226,364
Budget estimate, 1946	<u>1,088,000</u>
Change for 1946:	
Overtime decrease	-138,108
Other decrease	<u>-256</u>
	<u>-138,364</u>

PROJECT STATEMENT

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
1. Special research labora-				
tories in major agri-				
cultural regions	636,332	662,894	662,894	- -
2. Special research				
projects	370,407	405,261	403,346	-1,915 (1)
3. Administration of pay-				
ments to States, under				
Title I, Bankhead-Jones:				
Act	20,460	20,101	21,760	+1,659 (1)
4. Overtime costs	126,396	138,108	- -	-138,108
Unobligated balance	33,982	- -	- -	- -
Total available	<u>1,187,577</u>	<u>1,226,364</u>	<u>1,088,000</u>	<u>-138,364</u>
Transferred to--				
"Salaries and expenses,				
Office of Secretary of				
Agriculture"	+1,920	- -	- -	
"Salaries and expenses,				
Office of Administra-				
tor, Agricultural Re-				
search Administration"	+22,589	- -	- -	
Total estimate or				
appropriation ...	<u>1,212,086</u>	<u>1,226,364</u>	<u>1,088,000</u>	

(1) The reduction of \$138,364 consists of the \$138,108 decrease for overtime and a further reduction of \$256 to round off the appropriation.

The adjustment between projects is for the purpose of providing \$1,659, without increase in total funds, for increased clerical help which will be required in connection with the increase of \$536,292 submitted in the Budget for 1946 for additional payments to the States under the Bankhead-Jones Act.

WORK UNDER THIS APPROPRIATION

General: Section 4, Title I, of the Bankhead-Jones Act (approved June 29, 1935) provides that 40 percent of the funds appropriated in any one fiscal year pursuant to that Title shall constitute the "Special research fund, Department of Agriculture," and shall be available for (a) the establishment and maintenance of research laboratories and facilities in major agricultural regions of the United States and the prosecution of research at such laboratories; (b) special research projects approved by the Secretary of Agriculture and conducted by such agencies of the Department of Agriculture as the Secretary may designate or establish; and (c) administration of the provisions of the Act authorizing payments to States, Hawaii, Alaska, and Puerto Rico for research to be conducted by agricultural experiment stations. Section 1 of the Act specifies that the work conducted under the Special Research Fund shall be "research into laws and principles underlying basic problems of agriculture in its broadest aspects; research relating to the improvement of the quality of, and the development of new and improved methods of production of, distribution of, and new and extended uses and markets for, agricultural commodities and byproducts and manufactures thereof; and research relating to the conservation, development, and use of land and water resources for agricultural purposes."

The actual and estimated appropriations and the authorized appropriations under Title I of the Bankhead-Jones Act for the Special Research Fund since its establishment are as follows:

Fiscal year	Appropriated			Total	Total authorized
	Regional laboratories	Special research projects	Administration of Bankhead-Jones payments to States		
1936	\$200,000	\$192,000	\$ 8,000	\$400,000	\$400,000
1937	400,000	384,000	16,000	800,000	800,000
1938	600,000	576,000	24,000	1,200,000	1,200,000
1939	700,000	672,000	28,000	1,400,000	1,600,000
1940	700,000	672,000	28,000	1,400,000	2,000,000
1941	700,000	672,000	28,000	1,400,000	2,000,000
1942	701,528	480,003	24,769	1,206,300	2,000,000
1943	700,000	427,000	23,000	1,150,000	2,000,000
1944	733,100	456,045	22,941	a/ 1,212,086	2,000,000
1945	742,315	461,108	22,941	b/ 1,226,364	2,000,000
*1946	662,894	403,346	21,760	1,088,000	2,000,000

* Estimated

a/ Includes \$65,000 appropriated in the First Supplemental Appropriation Act, 1944, for overtime.

b/ Excludes \$23,473 transferred in 1945 Appropriation Act to "Salaries and expenses, Office of Administrator, Agricultural Research Administration."

The amount authorized, according to the terms of the Act, is distributed on the basis of 50 percent for regional laboratories, 48 percent for special research projects, and 2 percent for the administration of Bankhead-Jones payments to States. This percentage distribution was followed in the appropriations until the fiscal year 1942 when the appropriation for the Special Research Fund was reduced; however, none of the reduction was applied to the amount for regional laboratories. Since that time the amount for regional laboratories has been specifically stated in the appropriation act.

Special Research Laboratories in Major Agricultural Regions:

Nine regional laboratories have been established under the provisions of Sections 1 and 4 of the Bankhead-Jones Act of June 29, 1935, to provide a joint Department and State experiment station attack on problems of regional or national scope. These regional laboratories, which were established and are conducted in each case with the cooperation and participation of the State agricultural experiment stations in the respective regions, serve as focal centers for regional coordination and cooperation on research in the subjects under study by the laboratories. The work of the laboratories is centered especially upon phases of the problem under study which would be difficult or impossible for an individual State or a group of States to undertake.

The allotments made to Special Research Fund Regional Laboratories for the fiscal year 1944 and the estimated allotments for the fiscal years 1945 and 1946 are as follows:

Laboratory	Location	Allotment, 1944	Estimated allotment, 1945	Estimated allotment, 1946
1. Regional Vegetable : Breeding Laboratory:	Charleston, S. C.	\$76,900:	\$76,614:	\$65,770
2. Regional Pasture.. : Research Laboratory:	State College, Pa.	62,260:	64,552:	58,470
3. Regional Soybean : Laboratory	Urbana, Ill.	87,528:	92,515:	80,830
4. Regional Swine : Breeding Laboratory:	Ames, Iowa	63,700:	64,700:	62,818
5. Regional Sheep : Breeding Laboratory:	Dubois, Idaho	63,100:	60,239:	54,800
6. Regional Animal : Disease Laboratory:	Auburn, Ala.	73,934:	67,695:	60,126
7. Regional Labora- tory for Improve- ment of Viability				
in Poultry	East Lansing, Mich.	108,100:	111,200:	99,600
8. Regional Salinity : Laboratory	Riverside, Calif.	84,800:	96,410:	83,880
9. Regional Laboratory: for Research into the Relation of Soils to Plant, Animal, and Human Nutrition	Ithaca, N. Y.	106,390:	108,390:	96,600
For allocation by the Secretary to meet contingencies		1,244:	- -:	- -
Total available..		727,956:	742,315:	662,894
Transferred to "Salaries and ex- penses, Office of Administrator, Agri- cultural Research Administration" ...		+5,144:	- -:	- -
Total appropria- tion or estimate: Special Research: Fund Regional Laboratories ..		733,100:	742,315:	662,894

Examples of progress and current program: The following are examples of the progress made and work conducted at each of the laboratories during the fiscal year 1944:

Regional Research Laboratory for Research into the Heredity and Behavior of Vegetable Crop Plants for the Development of Improved Varieties Having Superior Adaptation to the Southeastern Region of the United States; (Approved by the Secretary, November 30, 1935; located at Charleston, South Carolina).

General Objective: The southeastern region is a potential source of the increased supplies of vegetables needed to provide an adequate nutritional level. The climatic conditions of the region are both favorable and unfavorable for the production of vegetables. On the one hand, the long growing season encourages the production of a wide variety of crops. On the other hand, the temperature and humidity conditions are favorable to diseases and insects, two very important factors handicapping production of high-quality products at a reasonable cost. The laboratory program aims to develop new strains or varieties of high-quality vegetables better adapted than any now available to conditions in the region. Improved commercial varieties and varieties adapted for home gardens will result not only in an increased income for producers but will also improve the nutritional level of the populace of the South and Southeast.

As a result of the breeding work of the laboratory four new open-pollinated sweet corn varieties have been released recently for commercial increase and introduction into trade channels. The varieties--Wappoo, Krowah, Carowah, and Edisto--are ear-worm resistant. This insect has long been a serious handicap in growing sweet corn in the South. The new varieties also meet the need for a medium-size, mid-season sweet corn of high quality. An attempt is being made to develop inbred strains of sweet corn adapted to southern conditions. One of the inbred lines was tested in Indiana where it was equal to the best ear-worm resistant variety represented in the test. In Ohio tests several of the laboratory lines showed promising degrees of corn borer resistance.

Two new varieties of a much-needed new type of cabbage for the South were released during the year for commercial increase and introduction into trade channels. The varieties were named Hugenot and Madison. They are round-headed, cold resistant, non-bolting, and designed to meet the specific climatic conditions and market requirements with which southern cabbage growers are faced. The varieties are also high in vitamin C content. Other breeding studies have yielded one late-maturing hybrid with the highest assay for vitamin C ever obtained for cabbage at the laboratory.

Breeding work with beans is being continued to develop new varieties adapted to specific areas and purposes. As an example of the cooperative efforts in this direction, the Florida Agricultural Experiment Station and the Department have released two new bean varieties, Florida Belle and Florida White Wax, which are now in commercial production. During the year the laboratory made very extensive vitamin studies of bean varieties and breeding lines and determined that a high vitamin C content was a heritable character. It was demonstrated that new varieties can be produced that contain more vitamin C than either of the parents of the new variety.

Tomatoes. During the year several new disease-resistant tomato breeding stocks were sent to collaborating stations in the region and to other points to determine their range of adaptation and reaction to disease under varying climatic and soil conditions. Favorable reports were received from Georgia, Florida, North Carolina, and Hawaii on such material. In addition, satisfactory progress is being made in breeding tomatoes for higher vitamin C content and for combined resistance to more than one of the following diseases; collar rot, gray leaf spot, Septoria leaf spot, Fusarium wilt, and leaf mold.

Adaptability of New Varieties to Quick-freezing and Dehydration.

Since vegetables are now marketed in a number of different forms, it seemed desirable to determine how the many new varieties would lend themselves to the quick-freezing and dehydration processes. Several strains of peas developed at the laboratory appeared to be well-suited for quick freezing. Certain strains of snap beans were superior to others for preserving by quick freezing. When dehydrated, cabbage strains and varieties differed moderately in appearance and only slightly in flavor. The dehydrated product was good but lost color during three and one-half months when not in cold storage. Some of the better strains of sweet corn yielded a dehydrated product that compared favorably with canned sweet corn. In dehydration, tomatoes lost 84 percent of their vitamin C and the finished product was not satisfactory in many respects.

New and Improved Testing and Breeding Techniques. In order to increase the accuracy and dependability of the results of the research and to speed up the breeding work, the laboratory has devised several improved or entirely new breeding and testing techniques. For example, methods were developed for making dependable comparative disease resistance (or susceptibility) tests in a matter of days instead of waiting for months for results under natural field conditions. These methods made possible the testing of many times as much material, in a mere fraction of the time and at a fraction of the cost, and were more dependable than conventional field methods. A method for preliminary testing of peas for cold resistance by dipping the foliage in supercooled liquids is giving encouraging results. Improved chemical methods for vitamin assay of new varieties and strains have speeded up the determination and reduced the cost of the assays.

Regional Research Laboratory for Research into Laws and Principles Underlying Pasture Improvement in the Northeastern Part of the United States; (Approved by the Secretary, February 20, 1936; located at State College, Pennsylvania).

General Objective. The Northeastern Region is an important source of milk for the centers of population along the eastern seaboard. Since milk is so essential to human diet, and the supply of milk and products made from it are inadequate to meet all the demands in our present war-time economy, it is obvious that anything that can be done to stimulate the production of milk in this region will be helpful. Perhaps the greatest single limiting factor in milk production is inadequate nutritious forage throughout the grazing season. The pasture improvement program of the laboratory was established to increase the productiveness of pastures during the entire grazing season and to provide surpluses in the form of grass silage or hay to be used as roughage for cows during periods when pasture is not available. These objectives, with effective cooperation of the twelve northeastern States, are being achieved by the development of better pasture management practices and by breeding improved strains of pasture plants.

Method of Increasing Forage Production. The renovation of pasture sods by the establishment of larger-growing grasses and legumes, by the use of adequate fertilization, and by a thorough disking to prepare the seedbed has increased forage production almost three times the first year and over six times the second year. Not only has the total production per year been greatly increased but a considerable part of this increased forage is obtained during the summer period when most permanent pastures are normally low in production. Preparing the seedbed with a heavy disk on a clay loam soil low in organic matter resulted in about three times more dry matter the first year than was obtained from shallow plowing. Furthermore, erosion was much less troublesome on the disked than on the plowed plots. Although these investigations have been underway less than three years, some of the results obtained are already finding application on farms in the Northeast. Extension agronomists are urging farmers in the region to adopt some of the procedures that have been developed.

When pasture plants are cut with a mower or grazed by animals, most of the plant parts above ground that manufacture food necessary for the continued growth of the plant are removed. In greenhouse experiments with perennial ryegrass at the laboratory it was found that following clipping the reserve food (carbohydrates) in the stubble and roots was drawn on heavily for renewed growth. At the higher temperatures the reserve food was exhausted most rapidly. An increase in the carbohydrates during the recovery period occurred first at the lower temperatures. The amount of stubble remaining after clipping or grazing and the temperature have an important bearing on recovery growth.

How to manage orchard grass-Ladino clover and brome grass-Ladino clover mixtures for hay and pasture to obtain high quality feed and maximum summer recovery after clipping is being studied. While early spring application of a nitrogen fertilizer increases the yield of the first cutting by stimulating the grass, it decreases the amount of clover in the second cutting to about one-half. Recovery after clipping was less rapid with brome grass than with orchard grass under comparable conditions. Both of these mixtures appear to have very promising possibilities for the Northeastern Region if proper fertilizer practices are developed.

It is generally believed that forage legumes such as alfalfa and Ladino clover respond more to phosphate fertilizer than do the commonly grown grasses. Trials on one soil with four grasses and four legumes, however, have shown that under greenhouse conditions and with adequate nitrogen fertilizer the grasses respond more to phosphate fertilization than do the legumes. These results are being checked under field conditions.

Seed Increase of Improved Varieties. Rapid progress has been made during the year in the production, testing, and seed increase of improved varieties of orchard grass, Kentucky bluegrass, colonial bentgrass, white clover, and Ladino clover. The breeding work of the laboratory is carried on in cooperation with six State experiment stations. One new variety of Kentucky bluegrass has continued in plot tests to produce superior yields of herbage particularly during midsummer. An additional area has been planted with this variety to provide for further seed increase.

Two characters that have limited the usefulness of orchard grass particularly in the northern part of the Northeastern Region are its early maturity and susceptibility to winter injury. Late maturing varieties available at present have proved to be considerably less winterhardy than the orchard grass produced commercially in this country. Substantial progress has been made in combining lateness and winterhardiness. In a replicated planting at State College, Pennsylvania, and Beltsville, Maryland, a few clones proved to be as late in maturity as the better late varieties and considerably more winterhardy. Five new varieties have been produced by planting these selected clones in isolated plots.

The ability of Ladino clover to persist in combination with certain grasses has been impaired in some cases by winter injury of the Ladino. Results obtained at the laboratory indicate the possibility of producing strains of Ladino with greater winterhardiness than the commercial material now available.

Inbreeding by self-pollination has proved to be one of the most important methods for the improvement of naturally cross-pollinated crops. In white and Ladino clover, self-pollination has been difficult and

frequently impossible due to the inability of pollen from a particular plant to cause seed to set on that plant. There has been discovered at the laboratory a self-fertility factor which, when present in a plant, makes it possible for that plant to produce seed with its own pollen. Hence, such plants can be inbred by self-pollination. The nature of the self-fertility factor is such that the plant breeder, by use of appropriate techniques, can introduce it into a strain or remove it from that strain at will. During the year, the self-fertility factor was introduced into a large number of strains of white and Ladino clover.

Diseases of Pasture Plants. In the past, relatively little importance has been attributed to diseases of pasture plants. Surveys conducted by the laboratory have shown that certain diseases may be widespread and destructive. Among these are stripe smut of Kentucky bluegrass, crown rust and Helminthosporium net blotch of meadow fescue, and leaf spots of orchard grass. The most effective method for control of diseases of pasture plants is through the development and use of resistant varieties. Successful selection of disease resistant varieties is dependent upon the production of a uniform epidemic of the disease. In the case of stripe smut, this has been difficult because of poor germination under controlled conditions of spores of the fungus causing the disease. A method has been developed by which the spores can be induced to germinate well in a few days, thus facilitating the production of the disease under experimental conditions.

Plants of meadow fescue have been discovered that are immune to crown rust both in the field and under artificial inoculation in the greenhouse. Other plants proved to be resistant to net blotch. Work has been initiated to incorporate resistance to these two destructive diseases in an improved variety.

Regional Laboratory for the Development and Production of Improved Strains and Varieties of Soybeans for Industrial Uses through Agronomic Investigations Supported by Plant Chemical Analysis; (Approved by the Secretary, February 20, 1936; located at Urbana, Illinois).

General. Evidence of the increased importance of soybeans to both agriculture and industry during the past decade is shown by the production which increased from 23,095,000 bushels in 1934 to 195,762,000 bushels in 1943. The crop's estimated value to the growers for beans, forage, pasture, and soil improvement in 1943 was over one-half billion dollars, and soybean processing is now a 400 million dollar-a-year industry. The need for protein and oil for food, feed, and other industrial purposes has made the soybean of vital importance in the present emergency. The rapid expansion of this crop into new areas has made it necessary to develop new strains or varieties adapted to varying environments. Satisfactory production of beans with high oil content must accompany the program for development of adapted varieties.

An intensive program to improve the variety Lincoln, released last year as a result of the laboratory program, is being undertaken. An attempt is being made to combine the desirable characteristics of Lincoln (yield and oil content) with the desirable characteristics of the variety Richland (lodging resistance and earliness). Among other promising crosses made by the laboratory is one between Mukden and Richland, which has produced segregates with high yield, earliness, lodging resistance, and a higher oil content than Lincoln. Wide testing of these strains is now being made to learn how consistently they perform in comparison with standard varieties.

Growers' interest in improved varieties is indicated by the experience with the Lincoln variety. From the 291 bushels of Lincoln seed harvested in the fall of 1942, 13,345 bushels of registered seed were produced in 1943. This year over 900 cooperators, representing a wide area in the soybean belt, will grow a total of 19,800 acres. It is conservatively estimated that there should be sufficient seed in the spring of 1945 to plant over 400,000 acres to this variety.

One of the most important developments of the testing program initiated in the South last year has been the evaluation of the Ogden variety in the upper South. This green-seeded variety, recently developed and released by the Tennessee Station, has a high oil content as well as a high yield. Tests at a number of locations throughout the South indicated the superiority of this variety for bean production in many areas but established the fact that it was not well adapted to the Coastal Plain areas of Georgia and South Carolina. It was further established that the variety has a tendency to shatter and is rather short for combine harvesting when grown on light soils. To secure improvement in height and shattering resistance and to develop strains both earlier and later than Ogden, it has been crossed with a large number of southern strains and many of the offspring have been backcrossed to Ogden. From these segregates, strains can be expected which will show the improved agronomic characteristics desired.

As the soybean acreage has increased, problems of diseases have become apparent. In order to aid in overcoming this new problem of growers, soybean disease work was started at the laboratory in the spring of 1943. It was discovered that, in general, diseases are a much greater problem in the South than in the North; however, with one or two exceptions the same diseases occur in both areas. The most serious diseases found in the South were southern blight, charcoal rot, and pod and stem blight. In the North the most important diseases were "bud blight", bacterial leafspots, and pod and stem blight. Seed treatment tests conducted cooperatively in nine North Central States gave a significant increase in stand over the check for all treatments but no increase in yield. A new wildfire disease was found to be widespread throughout the country. Greenhouse work has shown the infection and development of the disease to be similar to the disease of the same

name found in tobacco. In studying the "bud blight" disease it was found that infected plants yielded either of two viruses. One is the tobacco ring spot virus, but the other is an unknown virus which produces similar symptoms but has a thermal death point about 90° C. below the tobacco ring spot virus.

In breeding soybeans for improved composition, it is important that the chemical laboratory be able to check its own work from month to month and also be able to secure results comparable with other laboratories. With this thought in mind a study was made of the factors affecting the determination of percentage of oil in soybean seed. Moisture content of the seed is one of the more important factors, and it has now been demonstrated that the relative humidity of the air at the time of oil extraction affects the accuracy of the analysis for oil content. At a relative humidity of 80 percent in the extraction room, there will be from 0.4 to 1.0 percent more oil extracted than at a relative humidity of 20 percent. Based on these findings, the laboratory is attempting to hold the relative humidity of the extraction room fairly constant throughout the year. The findings have been published to aid other laboratories attain more consistent results.

Regional Research Laboratory for the Improvement of Swine through the Application of Breeding Methods; (Approved by the Secretary, December 22, 1936; located at Ames, Iowa).

General Objective. The swine industry produces approximately one-half of the total tonnage of meat of the Nation. Hogs sold from farms account for approximately 10 percent of the total farm income. In contrast with other agricultural products there has been relatively little improvement in the economic characters of swine which are highly important to the producers. Advances in the knowledge of nutritional requirements of animals and of disease control have aided the swine producers, but the efficiency of the animals they are working with has not improved materially for many years. The laboratory is attempting, through research, to develop breeding practices which when put into use will materially improve the efficiency of swine on the farm and in meeting the demands of the consumer.

The laboratory program was planned to test the application to swine of the principles that had been used in corn breeding. This procedure offered opportunity to test the usefulness of inbred lines for crossing to produce improved market hogs. The initial step in the program was to form inbred lines, using five breeds--Poland China, Duroc Jersey, Hampshire, Chester White, and Landrace--and three crossbred foundations--Landrace x Tanworth, Canadian Yorkshire x Poland China, and Landrace x Duroc Jersey. Three different rates of inbreeding are being studied for forming inbred lines. A total of 52 lines has been started, but 11 of these have been dropped for poor performance or converged to form new lines. Trials are under way to test the performance of inbred lines in crosses with each other, in top-crosses,

3-way line-crosses, and in breed crosses. Approximately 900 litters were produced in 1943 at the following cooperating stations in the North Central region: Illinois, Indiana, Iowa, Minnesota, Missouri, Nebraska, and Oklahoma.

Results of the program show that purebred hogs now available can be inbred slowly, increasing the inbreeding 3 to 4 percent per generation until inbreeding is increased to about 30 percent without much loss in productive characters. A breeder can follow this procedure and have an inbred line in 10 to 12 years with small risk since such lines can be expected to perform favorably in comparison with non-inbred lines. If inbred lines are desired quickly, close inbreeding such as half-brother x half-sister or brother and sister matings can be practiced. However, results at the laboratory show that the risk is greater than it is in increasing inbreeding slowly. Apparently about half of the lines inbred rapidly should be dropped for poor performance.

Hybrid vigor can be expected from crossing lines even within a breed or purebred hogs now available if the lines are inbred 30 to 40 percent. Crossing of inbred lines within a breed has produced on the average one-third to one-half of a pig more per litter at birth, 1-3/4 more pigs at 5 months, and approximately 30 pounds more weight per pig at 5 months than the parent line. When the inbred lines are of different breeds, the increase is greater than if the lines are of the same breed. From the results obtained it is clear that inbred lines should be produced from stock within a breed as nearly unrelated as can be found.

In general, some decline in fertility, survival, and growth rate can be expected from inbreeding but this can be offset by selection in herds closed to outside breeding animals if the inbreeding proceeds slowly. Selection for growth rate cannot be expected to offset the effect of inbreeding when it is faster than 15 percent per generation, while fertility in inbred lines cannot be maintained without some loss if the inbreeding exceeds 3 or 4 percent per generation.

Present results indicate that a little improvement in performance of pigs may result from the use of inbred boars on non-inbred sows. The increase appears to be about equal to that obtained in the past from using purebred boars on grade sows in comparison with non-purebred boars on similar sows. On the whole the results are closely similar to the gains made with hybrid corn in comparison with open-pollinated varieties, but further tests are needed to appraise the value of using inbred stock in various plans.

During the past two years farmers have taken 365 boars and 338 sows from the various projects. That farmers are generally pleased with the animals is expressed in the following excerpt from a letter from one of them:

"The four gilts and the boar arrived yesterday in first-class condition. I am very well pleased with all five, in fact I am enthusiastic about them. They show more quality than I expected--good hams, sides, length, bone and back. Easy feeding kind or I do not know my hogs. The boar is splendid also with all the above and good length. You are to be congratulated as you are making history in the hog world."

The only unfavorable reactions have come in those cases where the boar or sow failed to breed. At present it is not possible to estimate accurately whether or not more failures in breeding are being experienced with inbred stock than with non-inbred, purebred hogs.

Increasing the Effectiveness of Selection. Studies as to measures that may be used for increasing the effectiveness of selection emphasize that if progress is made in respect to productive characters, selections must be based on performance. The relationship between conformation and performance is very low. The use of selection indexes or performance scores in selecting for functional characters may speed improvement. Laboratory results indicate that an index or performance score based on about 3 to 5 traits would be sufficiently simple to make it practical. Traits showing the most promise for this purpose are: (1) Number of pigs farrowed; (2) weight of litter at weaning; (3) rate of growth to 5 or 6 months or rate of gain from weaning to market weight; (4) score for market desirability.

Data obtained in the laboratory have made it possible to estimate the part played by heredity in the variations of certain functional characters. For example, variations in productivity of sows are 15 to 18 percent hereditary and variations in rate of growth to market weight are about one-third hereditary. A study in respect to economy of gain suggests that heritability of this trait may exceed that found for rate of growth.

Regional Research Laboratory for the Improvement of Sheep for Western Ranges through the Application of Breeding Methods; (Approved by the Secretary, February 24, 1937; located at Dubois, Idaho).

General Objective: The sheep industry is essential to Western Agriculture. In this region vast areas are suited only for grazing, and range sheep are admirably suited to utilize certain areas not adapted to other range livestock. In addition, sheep utilize close to the source of production, part of the huge supplies of roughages, concentrates, and farm by-products grown in the region. While utilizing these agricultural resources, American sheep of the West produce approximately 275 million pounds of wool annually and supply about 65 percent of the lamb used by the consuming public. Efficient utilization of the range and of the resources of the region requires the development of types of sheep suited to the different environments of the area.

The laboratory is endeavoring to develop adaptable strains of sheep that for hardiness and for yield and quality of wool and lambs will be superior to any strains now available. To attain these objectives different systems of inbreeding, crossbreeding, and selection of proved sires are being employed to develop practical methods of improvement that can be incorporated in the sheepman's breeding program.

Weanling Traits in Relation to Selection. The laboratory made a study of the influence of sex, twinning, age of dam, and age at weaning on weanling traits using 2,183 Rambouillet lambs born in 1941 and 1942. Most of the differences were highly significant from the research standpoint although not all of them were large enough to be of practical importance to the sheepman at this stage in the development of the program. The percentages of the total variance of weanling traits attributed to the above influences were as follows: Weaning body weight 33; staple length, 16; body type, 15; condition, 9; neck folds, 8; and face covering, 5. It is planned to adjust the values given to weanling traits to take account of the more important differences found, thereby increasing the accuracy of selections based on individual performance and on progeny tests.

Information developed at the laboratory on the value of the open-face character in Rambouillet sheep has been widely publicized. Breeders of Rambouillet stud and range rams are in general widely accepting this information, and the percentage of open-faced ewes and rams is rapidly increasing in the commercial breeding flocks. Approximately 7,000 purebred Rambouillet ewes were inspected in Montana during the year, and it was observed that a considerable percentage of these were already fairly free from the wool-blind characteristic. Similar publicity on the disadvantages of body wrinkles has been responsible for a very general adaptation of smooth Rambouillets. Removing the heavy skin folds from the animals eliminates a source of annoyance at shearing time and reduces the customary tendency to cut the price on heavy pelted lambs. An additional advantage arises from the tendency for the longer staple fleeces, which command higher prices, to be associated with smoothness.

It is highly important in planning a breeding program to know the general heritability of the useful characteristics in sheep. During the year the laboratory determined that clean fleece weight has a heritability of 38 percent, this factor being 10 percent more heritable than grease fleece weight. Fleece length has a heritability of 36 percent. This latter finding will not apply if rams carrying 18 months of fleece are represented as having 12 months' wool growth, a not uncommon practice.

Wool Shrinkage Studies. In shrinkage studies of the 1943 wool clip, involving some 38,000 pounds of grease wool from the U. S. Sheep Experiment Station, it was clearly demonstrated that the former commercial shrinkage appraisals of wool have been too high. The studies also

showed that the small sample shrinkage investigations conducted at the laboratory during the past few years have a workable accuracy. The application of these shrinkage investigations to field conditions in one of the western States was responsible for lowering the shrinkage appraisals for wool and resulted in a saving of over 1 million dollars to the wool growers of that State on the 1943 clip.

The yearling Rambouillet ewes produced .44 pound more clean, scoured wool in the spring of 1943 than was produced by ewes of similar age in the spring of 1939. In addition the fleeces averaged almost .4 inch longer. The special long-staple line in the laboratory program had almost one-half inch longer staple and about one-fourth pound more clean, scoured wool than the average of the flock. The above results show the value of a carefully planned program for increasing wool production.

Management Practices. As an aid to improving sheep management practices, a number of sortings were made in accordance with commercial trade practices of the wool produced by mature Rambouillet ewes in 1943. The main sort constituted 79 to 84 percent of the total wool. The No. 1 burry sort made up from 10 to 15 percent of the total and had a decreased value of from 8 to 15 cents per clean pound due to the burs. The paint sort made up 4 percent of the total and the clean value per pound was about 15 cents less than for the main sort. The low and stained sort made up 1 percent of the total and this wool brought 34 cents less per clean pound than the main sort. There was an average of 1/2 pound of crutchings removed from each ewe before shearing, and this wool was valued at 25 cents less per clean pound than the main sort. Tags and sweepings averaged .13 pound per sheep and had a decreased value of 30 cents per clean pound than the main sort. Since all of these factors are taken into consideration by the wool buyer, it is essential that every effort be made to reduce the percentage of off-sorts in order to enhance the value of the entire fleece.

In order to determine the location and size of a small sample that could be used for making an accurate clean wool yield determination, the laboratory made a study of the fleeces of 40 ewes. In this study one-half of each fleece was scoured intact and the remaining half was scoured as 56 small samples. The results showed that a small sample of 35 gms. of grease wool taken from the middle of the side or shoulder is adequate for estimating clean yield of the whole fleece. This information will be of great value in speeding up scouring tests to determine clean wool yields.

Regional Laboratory for Study of the Mechanism of Infection in the Contagious, Infectious, and Parasitic Diseases of Domestic Animals and Poultry, and Methods of Control in the Southeastern Region; (Approved by the Secretary, February 24, 1937; located at Auburn, Alabama).

General Objective. Infectious and parasitic diseases of livestock constitute a limiting factor in livestock production. Especially is this true in the southeastern part of the United States where climatic factors are quite favorable to the persistence and spread of the organisms causing such diseases. Changing agricultural practices and recognition of the need for more animal products, such as milk and eggs, in the diet of people in the region have resulted in an increased livestock population in recent years. Measures are needed to control the many diseases and parasites which may affect this animal population to prevent not only direct losses due to death but also to make the animals efficient producers of meat, milk, wool, and eggs.

In order to limit the research to facilities available at the laboratory, the program was planned to determine means for controlling certain disorders for which practical control had not been devised. Principles developed in the original program will be used in determining the nature and means of control of other infectious, contagious, or parasitic diseases.

Use of Phenothiazine. There has been widespread interest in the use of phenothiazine as a treatment for the removal of stomach and nodular worms from calves and young cattle. Because there have been conflicting opinions in the South as regards the safety of this drug for cattle, experiments were conducted during the year to determine its effects. It was found that the internal administration of phenothiazine at the rate of 0.4 to 0.9 gm. per pound of body weight, the lower dose being twice the therapeutic dose, produced no permanent injury to calves on a good diet. Some of the calves receiving the largest dose did show symptoms of intoxication for 24 to 48 hours. Two weaned calves on a poor diet composed of low-grade Johnson grass hay and limited amounts of cracked corn developed no anemia or any other untoward symptoms following treatment with a standard therapeutic dose of phenothiazine. Calves receiving 0.4 gm. of the drug daily for 64 days grew normally and showed no bad effect from the medication. The above results showed that phenothiazine was not toxic to thin, poorly fed cattle, as had been feared by some veterinarians and livestock owners following the discovery of the relation of poor diets in horses to toxicity of the drug.

The administration to calves of 3 gms. of phenothiazine daily resulted in a disappearance of the stomach worms and nodular worm eggs in 16 days.

Phenothiazine and salt, mixed and kept before the animals at all times, is a satisfactory method of controlling gastrointestinal parasites of sheep. Tests of the same method with cattle did not prevent infection when the animals were exposed under natural conditions. Likewise the injection of the drug directly into the trachea, which is satisfactory for the treatment of lungworms in sheep, did not destroy lungworms in cattle.

Experiments proved that the lesser stomach worm, Ostertagia ostertagi, can produce very serious injury and at times even death in young cattle. Experimentally produced infestations resulted in loss of appetite and some diarrhea, but anemia was not observed. Post-mortem examination of 2 infected animals that died showed a severe gastritis, with large numbers of the parasites encysted in the mucosa of the fourth stomach. This parasite is very widespread in the South but has usually been considered less injurious than the common stomach worm. Phenothiazine is a satisfactory treatment for cattle infected with this parasite.

The laboratory carried out experiments with Eimeria bovis, one of the two most serious of the coccidia that parasitize cattle. It was found that inoculation of susceptible young calves with 1,000 oocysts produced infection without significant clinical symptoms, while inoculation with 25,000 oocysts produced a non-bloody diarrhea that persisted for only a short time. On the other hand, inoculation with 125,000 or more oocysts usually produces severe symptoms--bloody diarrhea, loss of appetite, elevation of temperature--with a fatal termination. The period required for the completion of the life cycle in the host was 18 days. The principal lesions observed on post mortem examination were hemorrhage and erosion of the mucosa of the colon and cecum.

Naturally-acquired or experimentally-induced light infections with Eimeria bovis produce a marked immunity to subsequent inoculations with large numbers of oocysts. Good sanitary practices in the calf barn will prevent exposure to large doses but usually will not prevent slight exposure. Thus, calves which are raised under good conditions develop resistance without suffering from a clinical attack of coccidiosis.

The laboratory has developed satisfactory methods for the production of johnin, the agent used in the diagnosis of Johne's disease, from two strains of Mycobacterium paratuberculosis, the causative organism of this disease. Large amounts of this material have been produced for testing cattle and for fractionating to produce a more specific allergen to be used in diagnosis.

In studies on reactions of cattle (15,404) sensitized to different species of Mycobacterium, it was found that there was considerable variation in the reaction of individual animals sensitized to the same material and that the average sensitivity was greater than that seen in natural infections with Johne's disease. There was also a gradual loss of sensitivity. Phlein, the allergen prepared from Mycobacterium phlei, produced a reaction in animals only if they were sensitized to Mycobacterium phlei. On the other hand, each of all the other allergens used in this work--tuberculin of the human, bovine, and avian strains, as well as johnin--gave a reaction if the animal was sensitized to any one of the organisms causing the different types of tuberculosis or Johne's disease. The cross reactions

indicated a very close relation between Johne's disease and avian tuberculosis, and between human and bovine tuberculosis. The reactions of cattle sensitized to Mycobacterium tuberculosis (human and bovine) showed skin reactions that tended to be hard and circumscribed, whereas those sensitized to Mycobacterium paratuberculosis and Mycobacterium tuberculosis (avian) showed a tendency towards soft, diffuse skin reactions. Further exploration of this finding may be found of value in reading reactions to diagnostic agents with more accuracy than now obtains.

Regional Research Laboratory for the Improvement of Viability in Poultry; (Approved by the Secretary, December 23, 1937; located at East Lansing, Michigan).

General Objective. Poultry and poultry products have played an important part in the war effort by supplying eggs and meat for both the armed and the civilian populations. Added to the poultryman's problems of reduced feed and labor supplies has been the ever present problem of losses due to diseases and disorders. More chickens die from lymphomatosis (avian leukosis complex) than from any other one disease. It has been estimated that during the fiscal year 1944, the total financial loss to producers from this disease was at least \$50,000,000 for the entire United States. The disease is widespread, occurring in every State and to some extent in about every flock.

Although the exact cause of lymphomatosis has not as yet been definitely determined, this laboratory has demonstrated progress in the control of the disease through breeding for resistance. Information is being accumulated on the means of transmission. The common manifestations of this disease are paralysis, eye involvement, and enlarged livers.

Breeding as Related to Resistance. At the laboratory the practice of breeding year after year from males and females whose brothers and sisters and whose progeny show the lowest incidence of lymphomatosis when all such birds are equally exposed to the infection has resulted in the development of lines of White Leghorns which are resistant to the disease, as demonstrated by fewer cases and a longer average life span. The variation in mortality that has occurred between lines 9 and 13 is typical of that taking place between the other lines developed and maintained at the laboratory. Susceptible line No. 9 showed an average mortality from lymphomatosis to 300 days of age of 47.2 percent among the 274 birds hatched in 1941, 1942, and 1943. In resistant line No. 13 the average mortality from this disease for the 3 years among the 152 birds produced was only 11.1 percent.

The principle of breeding chickens for resistance to lymphomatosis as demonstrated at the laboratory can be used extensively and effectively by poultry breeders in reducing their mortality from this disease. Its

direct use is limited to those breeders who pedigree their birds and keep accurate viability records. The rate of progress will be slow. However, the indirect benefits of such a program on the part of advanced poultry breeders through the sale of breeding stock, hatching eggs, and chicks should be most helpful in reducing losses from lymphomatosis.

The laboratory has definitely established the fact that transmission of lymphomatosis may take place under natural conditions when healthy birds come in contact with infected stock. Day-old chicks from stock "free" of lymphomatosis were hatched, brooded, and maintained with other chickens in which many cases of the disease developed. By the time 165 chickens from the "free" stock attained an average age of 300 days, 26.7 percent of them had died from lymphomatosis. One hundred of their brothers and sisters which were brooded and maintained in isolation and under rigid quarantine were free of any gross manifestations of the disease at 300 days of age.

One of the most significant results obtained at the laboratory during the year has been the development of additional evidence that lymphomatosis is transmitted by way of the hatching egg. If this evidence of egg transmission is found to be definite and positive, it will have a far-reaching effect on the poultry industry. Management practices to maintain free flocks would then require: (1) the identification of breeding stock that is not infected with the disease; (2) a rigid sanitation and quarantine program in order to maintain the breeding stock free of the disease; (3) the incubation of eggs from free stock in isolated quarters which are not contaminated with other eggs, and (4) possibly the brooding of chicks in isolation for a short period of time.

Considerable success has marked an effort during the year in reproducing lymphomatosis by inoculation. Instead of having to wait months for natural development of the disease, inoculation has produced conditions simulating the parent disease in 7 to 10 days. If pathological studies confirm the validity of this procedure, it is estimated that with the same housing facilities, the research on certain phases of the problem could be accelerated.

The laboratory found that a transmissible fowl tumor (Olson) when implanted in a total of 312 chickens by various routes and in appropriate dosages produced a high incidence of local tumors that upon regression rendered the birds immune to subsequent implantation of the same tumor strain. Immunity obtained with this tumor is of particular interest because (1) it appears in all birds that have survived an active growth of the tumor, (2) it apparently cannot be overwhelmed by very large or repeated doses of the same agent, and (3) it is present over a prolonged experimental period. The excellent results obtained in establishing immunity to the "Olson" tumor gave rise to studies of the immunological properties of lymphomatotic material when inoculated in young chickens

by various routes and in appropriate dosages. The preliminary results are so encouraging that this phase of the program is being intensified.

It was reported last year that chicks had been raised to 300 days of age under special conditions without any manifestations of lymphomatosis. These same birds have now attained 700 days of age without any occurrence of the disease. This freedom from disease may be attributed to three factors: (1) The chickens came from parent stock which was not infected with the disease, (2) they were hatched separately from other chickens and were hatched in the pen where they were maintained, and (3) they were raised and maintained in isolation and under rigid quarantine. An attempt to reduce the extent of isolation and quarantine necessary to raise chickens from free parent stock without having the disease develop met with only partial success. It was apparent, therefore, that complete isolation and rigid quarantine would be required in the development and maintenance of stock free of lymphomatosis.

Regional Laboratory for Investigations of the Relationship of the Salinity of Irrigation Waters, and of Soil Conditions to Plant Growth and Related Factors Involved in a Permanently Successful Agriculture in the Western Region; (Approved by the Secretary, December 23, 1937; located at Riverside, California).

General Objective. There are about 20 million acres under irrigation west of the Mississippi River of which an estimated 9 million acres have had their productivity impaired or threatened by excessive accumulation of soluble salts. The prevention of salt accumulation in irrigated districts, and the removal of salts present in harmful amounts is dependent upon good drainage. The laboratory is developing and improving methods of leaching salts from soils through improved drainage, is selecting salt-tolerant crops or strains of these crops, and is determining what cultural practices will reduce salt accumulations or their effects upon plants. The aim of this program is to make available for the production of food, feed, and fiber all land suitable for cultivation and to keep that land in suitable condition for a continuing agricultural enterprise.

In the San Joaquin Valley large tracts of land are irrigated by pumping from underground supplies. These supplies are diminishing and the pump lift increases about 10 feet a year. It is highly desirable that these underground basins be replenished with spring flood waters. An obstacle to this procedure is the slow rate of water infiltration on some of the spreading lands which are slightly saline. A joint investigation of this problem is being made by the laboratory, the Bureau of Reclamation, the Soil Conservation Service, and two Water Storage Districts. The preliminary results have shown that the greatest limitation to water infiltration occurs in the surface foot of soil, that entrapped air reduces water intake until it is dissolved

and removed by the percolating water, and that the infiltration rate gradually decreases. Factors causing this gradual decrease are dispersion of the soil and plugging of the soil pores when continuously leached with very low salt content water (below 100 parts per million) and because of growth of microorganisms in the soil. It is expected that the results of this study will lead to management practices which will solve the problem of recharging the underground water supplies in this area. The results should also find application in other areas with similar problems.

The laboratory has inaugurated a test to determine what percentage of the irrigation water applied must be leached through a soil to prevent salt accumulation. The test has been in progress since last July and 8 crops of alfalfa have been harvested from the experimental plots. Six waters are used having 40, 60, and 80 percent sodium and at 2 levels of concentration, namely, $1/3$ and 1 ton per acre foot of water. Yields on the soils which received water of 1 ton salt per acre foot were about 15 to 20 percent less than with the $1/3$ ton per acre foot water. With 10 percent of the applied water devoted to leaching no appreciable accumulation of salt has occurred. The final results of this phase of the program will be helpful to farmers and irrigation districts in planning the size of canals and use of water so as to prevent salt accumulation.

Because poor stands of alfalfa and other crops are frequently due to reduced germination of the seed, a study was undertaken to determine the effect on germination of salt content of the surface few inches of soil. It was found that with alfalfa seed, the rate of water intake and germination are progressively reduced as the concentration of salt in the soil is increased. Wheat seed appeared to be more tolerant than alfalfa but there was a significant reduction in germination as saline conditions increased. On the basis of information obtained through germination studies, it is believed that improved procedures can be developed for preparing the soil and seeding in saline soils.

During the year the laboratory studied the salt tolerance of 16 pure lines of cotton selected and supplied by the Bureau of Plant Industry, Soils, and Agricultural Engineering. These lines were grown in soil and sand culture tanks with single salts added to a basal nutrient solution. The salts used were: calcium chloride - 7,500 p.p.m. (parts per million), sodium chloride - 5,900 p.p.m., and sodium sulfate - 11,320 p.p.m. These concentrations are comparable to field conditions where cotton yields are reduced about 25 percent from maximum because of salt. There were pronounced differences in growth and yield of the several varieties under the same treatment. The effect of genetic constitution on salt tolerance was illustrated by the behavior of three varieties. Sakel was very intolerant of salt, Amsak (Sakel x Pima x Sakel) was even more so, while Sakel x Pima, a widely grown variety in the Southwest, was the most tolerant of

the three, indicating that Pima was contributing salt tolerance to this hybrid. Shafter Acala, a Department selection, was very tolerant and high-yielding, while Meade, a new variety with many desirable characteristics, gave low yields in the presence of any of the three salts. These results will be helpful to cotton breeders and growers in the selection of varieties for saline areas.

Flax is being grown rather extensively in the Southwest and for that reason its salt tolerance was investigated. It was found that flax was only moderately tolerant to salt. The yield of seed was reduced 17 to 33 percent when the culture solution contained approximately 2,850 p.p.m. of added sodium chloride, 3,500 p.p.m. calcium chloride or 5,400 p.p.m. sodium sulfate. At equal concentrations, sodium sulfate was the most injurious, calcium chloride the least, and sodium chloride intermediate in toxicity. High salt concentrations also reduced vegetative growth, size and number of fibers produced, and delayed flowering and setting of bolls from 5 to 18 days.

A five-year study of the tolerance of peaches to chloride and sulfate salts will be concluded this season. The results show that peaches are not tolerant of salt concentrations in excess of two and one-half atmospheres osmotic pressure regardless of the kind of salt present. The vegetative growth and the yield and quality of fruit are reduced as the salt concentration is increased. Chloride salts were more toxic to peaches than sulfate salts at equal concentrations. As far as is known, this is the only controlled experiment in tree crops dealing with salt tolerance. These results will be useful in evaluating the effect of marginal saline conditions on growth of peaches and on their quality. They will explain, also, why in some areas fruit growing has been marginal or unsuccessful without any known reason. With the completion of this work on peaches, investigations of other phases of the salinity problem will be undertaken.

Regional Research Laboratory for Research into the Relation of Soils to Plant, Animal, and Human Nutrition; (Approved by the Secretary, January 1, 1939; located at Ithaca, New York).

General Objective. During recent years there has been an increasing interest in the physiological disorders of man and animals in certain sections of the country. The causes of many of these disorders have been identified as a deficiency of one or more essential nutrients in the food or feed eaten. Some soils contain undesirable elements which inhibit the growth of plants or adversely affect the growth of animals. From a national nutrition standpoint it is necessary to know which areas are producing adequate foods and feeds, and which areas are supplying inadequate foods and feeds to the men and animals residing there. In the latter case it is essential to know the extent and nature of the deficiency so that it may be corrected by direct addition to the diet or supplied to plants in the form of fertilizers or by other agricultural practices.

Evidence has been obtained that phosphorus fertilization does not necessarily increase the nutritive value per ton of forage, even though increased yields are obtained. This has been shown by both chemical studies and animal experiments at the laboratory. In support of this evidence Sudan grass was grown in a phosphorus deficient soil with and without phosphorus fertilization. While the fertilization increased the total yield, chemical analyses of the two crops did not show a significant difference between the two in protein, fat, and carbohydrate content but the crop grown without phosphorus addition was slightly higher in this element. Growth of lambs fed the phosphorus fertilized Sudan grass was not superior to that of lambs fed the grass not fertilized. There was no difference in the digestibility of the two products, and the lambs in both groups stored an equivalent amount of nitrogen.

Other observations at the laboratory suggest that intensive fertilization of forage crops with the major elements may result in an actual decrease in nutritive value where soils contain minimum supplies of certain micronutrients. In the podzol soil regions of the country, the application of large quantities of nitrogen and phosphorus to obtain better yields and more highly nutritious forages such as the clovers, may result in a significant decrease in manganese and other micronutrients. In the coastal plain regions and on the lighter textured soils elsewhere, the application of lime may reduce the micronutrient content of the plant well below that required by the animal for adequate nutrition. In such regions, it will be necessary to supply with the fertilizer those elements that are deficient in the soil.

Manganese was shown to be necessary for sound bone development and for fertility. In experiments with rabbits deficiency of manganese in the diet resulted in crooked and brittle bones. In addition, the leg bones were shorter and contained less mineral matter than normal bones. Microscopic examination of bone sections showed a marked derangement in bone structure which was interpreted as a retardation in bone formation. Males on this ration became sterile because of severe degeneration of the testes. In the case of females, the genital organs were definitely undersized, but microscopically they appeared normal. These observations are of special significance because of the field data that are being accumulated at the laboratory regarding animal troubles occurring in areas where the herbage is low in manganese.

Results have shown that doubling the number of chromosomes in certain stocks of pure yellow corn resulted in the production of a plant of higher nutritive value. The nitrogen content was increased by 15 percent in the grain and by 20 to 34 percent in the stover. The higher nitrogen content of the stover was accompanied by a corresponding lower content of crude fiber and cellulose, the less digestible carbohydrates. These results indicate that it may be possible to produce roughages which are high in protein and total digestible nutrients.

The laboratory is attempting to determine the effect of mineral elements in the soil on the plants grown on them and the effect in turn on the humans and animals consuming the plants. During the past year the food problems of the war emergency and its aftermath have been kept in mind in continuing the general program of the laboratory with the objective of obtaining results which might find practical application as rapidly as possible. The laboratory has also rendered assistance in connection with a number of specific problems of the armed forces, dealing with the vitamin content of special rations, and similar problems.

Sunshine increases the vitamin C content of food crops, according to studies made at the laboratory with turnip greens and tomatoes. When these crops are grown with full exposure to summer sunshine they have much more vitamin C than those grown in the shade or at low light intensities. Controlled studies on the effect of light intensities on vitamin content have shown that turnip greens had nearly 10 times as much vitamin C after one week at 5000 foot-candle intensity (equivalent to summer sunshine) as did comparable greens after one week's exposure to 200 foot-candle intensity (equivalent to heavy shade). Tomatoes grown in sunshine had about 60 percent more vitamin C than those which were shaded so as to decrease light by 75 percent. The vitamin content changed rapidly when plants were shifted from sunshine to shade and vice versa. It seems probable that a period of cloudy weather prior to harvest would markedly decrease the vitamin C content of food crops.

Studies during the past year have indicated that the boron supply available to plants may markedly influence the mineral content and thus the mineral nutritive values of food crops. Tomato plants were grown under carefully controlled conditions of boron supply which ranged from deficient to toxic levels. Analyses of the plants for potassium, calcium, magnesium, sulphur, phosphorus, sodium, iron, manganese, molybdenum, copper, zinc, protein-nitrogen, nitrate-nitrogen, and ammonium-nitrogen in the leaves were made. Large and significant variations in all of the constituent elements except sodium could be correlated with differences in the boron supply. The variations in the content of the constituent elements within the plant were not correlated with one another, nor with the differences in the growth of the plants as a result of altered boron supply. A differential absorption by the plant of the elements from the nutrient medium was indicated. It seems possible as a result of this work that relatively small differences in boron content between different soils might have a marked influence upon the ability of the plants to absorb mineral elements from the soil. Thus, insofar as the nutritive value of a crop is determined by its mineral content, the nutritive value may be closely related to the boron content of the soil.

Continuation of previous work has provided additional evidence to show the mineral nutrient supply has little influence upon the vitamin content of food crops over ranges of supply sufficient to influence appreciably the growth and development of the crop. With few exceptions, the ascorbic acid, carotene, riboflavin, nicotinic acid, and thiamine contents of turnip greens were influenced but little by variations in the supply of such mineral nutrients as calcium, potassium, magnesium, nitrogen, phosphorus and sulphur. There were some indications that the boron supply to the plants produced appreciable effects upon certain of the vitamins.

Special Research Projects:

Part of the Special Research Fund is available to the Secretary of Agriculture for special research projects. This part of the fund is intended primarily to enable the Secretary to undertake studies which are basic to agriculture in its broadest aspects and which may be conducted by such agencies of the Department as he may designate or establish. The act requires that the research under this fund "shall be in addition to research provided for under existing law (but both activities shall be coordinated as far as possible)." There are many problems which arise, the solution of which requires research of fundamental character in order that further progress may be made. The appropriation enables the Secretary to undertake such work as the need arises within the limits of available funds.

In administering, budgeting, and using the Special Research Fund, no money is allotted to the bureaus which conduct the research until carefully written project plans and cooperative arrangements are outlined in detail and approved by the Secretary. Allotments are adjusted on the basis of changes in relative needs of the projects which are under way.

Examples of Progress and Current Programs: During the nine years that the Special Research Fund has been available, 99 separate research projects have been undertaken and 71, constituting 72 percent, have been terminated. Of those terminated, 37 were relatively short-time studies designed to provide information for immediate needs. Of the other 34 projects, 9 were terminated in 3 years, 7 in 4 years, 3 in 5 years, 6 in 6 years, 2 in 7 years, 4 in 8 years, and 3 in 9 years. Seven projects were terminated in 1944 and 3 new projects have been initiated in 1945. A total of 28 projects, involving 8 bureaus, are now under way.

The majority of these 28 projects are concerned with fields of work basic to agriculture in its broadest aspects. Many are supplying results especially valuable in the war effort. As the work progresses and as the needs vary, changes in emphasis are made from year to year. With the completion of work on one phase of a problem, the attack may be directed to another phase requiring solution.

The following are examples of progress made in special research projects during the fiscal year 1944:

Flue Curing Tobacco. Results obtained in this experiment furnish, for the first time, a rather clear picture of the factors that make up good curing procedure and show the rate of progress and the completeness of the curing process in relation to temperature and humidity conditions.

Good curing results were obtained in 4-1/2 days by gradually increasing the temperature from 90° F. to 170° F. and decreasing the relative humidity from 90 percent to 20 percent. During this curing process there was a total loss of 83 percent of the original weight of the tobacco.

The essential chemical changes in the leaf were practically completed at the end of 3 days. The most important change involves the conversion to sugar of the starch which in the green leaf averages 25-30 percent. This is important because a high sugar content is a controlling factor in the quality of flue-cured tobacco.

As a result of a proposal from India, experiments were conducted involving a radical departure from the usual flue-curing procedure. Since thorough drying of the leaf midrib is necessary to avoid later deterioration in storage, it was proposed that the midrib be partially crushed in preparation for curing in order to expedite final drying. Crushing at 3 different degrees was accomplished by use of a small wooden roller. The rate of drying of the midrib was roughly proportional to the degree of crushing resulting in a saving of up to a half day in the cure. Contrary to expectation, there was no discoloration of the leaf from the sap released by crushing the stem tissues.

These results will furnish a sound basis for improvements in flue-curing methods and procedures. Of perhaps even greater value, the results may be found useful in the chemical evaluation of quality in leaf tobacco. The findings, furthermore, should have very wide application in appraisal of quality of tobacco in relation to soil types, fertilizer practices, varieties and strains, and production methods and conditions.

Improved Techniques for Collecting Agricultural Information. Under present conditions there is a special need for quick and accurate methods of estimating present and future agricultural production facilities required and farm labor available and needed. Such estimates are required to plan war production programs effectively and to guide the distribution of facilities necessary for attaining established goals. Similar information will be needed to assist farmers in making adjustments to meet postwar conditions. Shortage of personnel and greatly curtailed travel facilities have made it necessary to develop improved methods of utilizing data obtained by mailed

inquiries and from available sources such as assessors' records. Other methods of collecting necessary facts not available from the above sources are likewise being investigated.

In order to develop the most efficient sampling design for making economic surveys of individual farms, a scheme known as the "Master Sample" was developed under this project to obtain representative facts with restricted travel and personnel facilities. Farms in the Master Sample are selected on the basis of 100,000, 200,000, and 300,000 farms which will be most representative of the 6,096,799 farms in the country. The difference in the numbers is to take account of the variations in the size of sample which may be made for various purposes. The concept behind the Master Sample contemplates that by using the same farms for various surveys, a mass of detailed information will be developed which should prevent repetition of certain items in questionnaires or surveys covering the same farm. Once the information is collected, for example, as to the size of the farm, the type of livestock produced, etc., subsequent surveys covering this farm could omit questions on these points. The accumulation of various types of data covering the farms in the sample will provide a more comprehensive coverage than has been possible in the past. The sample is so designed that it can be utilized if only a State or region is to be surveyed. In the case of surveys employing the full sample of 300,000 for the country if the results are multiplied by 18, they will provide an estimate as to the application of the results of the survey to the agriculture of the country. If smaller samples are used, the expansion factor is modified accordingly. In order to test the accuracy of this method of sampling, the facilities of the Master Sample were used in drawing 101 counties to serve for estimating United States totals of certain agricultural items. This sample was divided to form smaller samples of 51 and 27 counties each. County totals of 1939 Census were expanded for these items to produce an estimate for the United States. Errors of the estimates of the first five items expanded averaged about 4 percent for the 101 and 51 county samples and 5 percent for the 27 counties.

Attempts were made to estimate State totals of crop and livestock items from the totals for a few sample counties. Results showed that accurate totals could be derived from a sample as small as 10 counties when efficient methods of expansion are applied to the data.

Information gained from these studies should lead to more efficient sampling designs for estimating agricultural items. The results of the studies with the Master Sample will have practical application not only in the statistical program of the Department but in other agencies as well. The Bureau of the Census plans to use the results of some of these studies in connection with its census of agriculture.

In addition to investigating the problem of determining the farms in the country which would be most representative of our agriculture, attention is being given to the development of techniques for utilizing

information obtained from these farms to provide reliable estimates of specific items. A study of the 1942 Rural Carrier livestock data in North Carolina showed that farm land is not an efficient basis for estimating livestock numbers. Excellent estimates, however, were obtained when numbers on hand the preceding year were used as a basis for estimating current animal population.

Studies have been made to develop techniques for increasing the accuracy of procedures of buying to plot experiments with crops. There has been need for methods of sampling which would reliably indicate the yield of such plots with a minimum amount of labor and taking into account technical problems of plot work. Preliminary results indicated that with corn plots, systematic samples of producing stalks give more efficient estimates than random samples of 8-foot segments adjusted either for number of stalks or ears. For oats, it was found that the use of an area 24" x 26" as a sampling unit gave an approximately 60 percent more efficient yield estimate than an area 36" x 36".

The results of these studies, which are conducted in cooperation with State agricultural experiment stations, are being put to use as rapidly as they are found practical by sampling agencies and by research workers to increase the accuracy of their results.

Effect of High Cereal Diets on Human Growth and Health. During emergency periods when food supplies are restricted, diets are likely to consist largely of breadstuffs, cereals, and potatoes. In this situation, the diet is high in carbohydrates and low in proteins and fats. It is important, from a practical standpoint, to determine whether high cereal diets have any detrimental effects upon nutritional well-being.

Investigations have been initiated to ascertain the effects of high cereal diets on the growth and health of laboratory animals which will serve as a guide in planning human dietaries. Analyses of experimental diets containing a high percentage of rice or corn have shown that the principal deficiency in such diets lies in the very low calcium and comparatively high phosphorus content. Young animals cease to grow after a short time on these diets, but growth is resumed when either additional calcium or vitamin D is given. Vitamin D alone added to the low calcium diet appears to stimulate greater gains in weight than does the addition of calcium alone. Yellow corn meal appeared to give slightly better growth than white corn meal, and under-milled rice seemed slightly superior to polished rice in promoting growth.

The rice diets had no effect upon the fertility of either male or female animals. The mothers, although bearing average litters of normal young, were not able to rear them, presumably due to failure of lactation. Young sired by males on experimental diets and reared by females on normal diets showed no abnormalities. In contrast with

these results, animals of both sexes receiving either yellow or white corn meal have been infertile even when mated with animals of the opposite sex on normal diets.

Present work is concerned with determining other physiological effects of high cereal diets.

Blue Mold Disease of Tobacco. Control methods have been developed for tobacco blue mold disease which again caused widespread damage to plant beds throughout South Carolina in 1944, delaying planting 2 to 3 weeks or longer. A number of conditions make late plantings undesirable, especially the meadow nematode, which has become increasingly serious in recent years. Because of the above production problems, satisfactory control methods have been needed to permit planting at the proper date and also to save seed by eliminating the necessity of more than one planting.

Methods for controlling blue mold disease of tobacco were reported last year but because of the difficulties of putting them into practice, comparatively few growers made use of them. Recent efforts have been concentrated on the development of improved control methods that are simpler to use. Special emphasis has been placed on dust treatments. Although dusting is somewhat more expensive than spraying, it requires less time, an important factor under present conditions. Experiments with spray treatments were also continued since this method appears most practical for the large grower with extensive plant beds.

As a result of the recent tests 5 dust preparations have been found to give complete blue mold control and 5 spray mixtures were all more effective than the standard copper-oxide-oil mixture. The addition of zinc salicylate to both dust and spray mixtures greatly increased their effectiveness. In fact, two materials when used alone were not satisfactory but with the zinc salicylate added, gave excellent blue mold control.

Sheep for Navajo Indians. In the early stages of this project, the type of sheep best adapted to the economic needs of the Navajo Indians was determined.

This desired type is being developed by mating Navajo ewes with pure-bred Romney and Corriedale rams, followed by selective linebreeding matings of the offspring of the first and succeeding generations. A fair percentage of the animals produced closely approach the desired objectives in fleece and body type. The important need of the Navajo Indians is for a sheep producing wool of a satisfactory quality for weaving. Mutton quality, while desirable, is of secondary consideration. The main emphasis in the research, therefore, has been placed on improvement of the wool.

In 1943 the grease fleece weight of the yearling crossbred ewes averaged 7.5 pounds, with an estimated yield of 4.7 pounds of clean wool. This represents an increase in wool production of about 96 percent, compared to that of the foundation Navajo ewes. While the general level of fleece quality has been raised considerably in these crossbred animals, uniformity of fleece type has not yet been achieved.

All of the wool produced by the experimental flock has been used on the reservation for hand-weaving. The rugs produced from this wool were of excellent quality and sold at premium prices. In 1943, 22 mature rams and 24 ram lambs were sold to the Navajo Livestock Improvement Association, and one ram was sold to the Phoenix Indian School. An individual Indian purchased 25 surplus ewes for breeding purposes. As improvement is made in the laboratory flock, better rams are being made available for use on the reservation.

Results to date indicate that the present approach of cross-breeding will succeed whereas the earlier concept of improving the Navajo strain by selection has offered little prospect of developing the type of sheep needed by Navajo Indians. Work under the earlier approach did result in an appreciable increase in the average fleece weight of the selected Navajos but only limited progress was made in improving the average level of fleece quality. The present approach of cross-breeding has already resulted in a considerable increase in the average level of fleece quality.

Egg Allergens in Typhus Vaccines. Fertile eggs inoculated with virus are the only known means of producing vaccines that convey immunity against typhus and certain other epidemic diseases. Diseases of this type comprise a most serious hazard in the European and South Pacific war zones. Fertile egg vaccines, of which typhus vaccine is the most important, provide effective protection against epidemic diseases that in all previous wars have decimated armies and civilian populations alike.

Under the present practice of injecting large doses of typhus vaccine, serious hazards accompany the use of this vaccine if the egg proteins are not excluded in its preparation. These hazards are: (1) Establishment of specific sensitiveness to subsequent doses of the same vaccine or other chick embryo vaccines, thus preventing the use of any vaccine of this type; (2) establishment of sensitization to egg protein in foods, requiring exclusion of egg-containing foods from the diet; (3) disabling or even fatal shock if the recipient is specifically sensitive to egg protein.

Because of the research on allergens of agricultural products which the Department was conducting, the Army Medical School requested cooperation in the problem of allergens in typhus vaccines. Current emphasis of the work was changed accordingly. It was demonstrated in 1943 that experimental lots of chick-embryo vaccines contained:

small but potentially significant quantities of egg allergens. These findings indicated the need for investigations designed to identify and estimate the quantity of these allergens and to determine their relationship to the nitrogen and protein content of the vaccine. Such research complements the investigations of the Army Medical School to produce a typhus vaccine with a high level of protective activity.

On the basis of the preliminary results, samples representing modifications of current methods of manufacture of typhus vaccine are tested for the Army Medical School to detect and characterize the allergens of the vaccines. The sensitizing capacity of each vaccine has been determined. This capacity has been shown to be due to certain proteins which have accompanied the protective agent recovered from the chick embryo. Among these proteins are some known and some unidentified allergens which appear to be normal components of eggs.

This work has been of such great assistance in the endeavor to improve typhus vaccine that Col. Harry Plotz of the Army Medical School wrote:

"You and your group of investigators have been of inestimable value to us in the joint investigations which we have undertaken and I sincerely hope that this cooperation will continue until our problem is solved. The Army Medical School has no set-up or qualified personnel to carry on the work which you are so ably carrying on for us."

Because of the restrictions on divulging information of a military character, it is not possible to review the significant findings and conclusions developed from the research on egg allergens.

While the results obtained are of particular importance to the war effort, they will be of value in the increased utilization of eggs in the production of various vaccines under normal conditions.

Effect of Hormone Treatments on Experimental Animals. In recent years considerable attention has been given to the use of hormones for overcoming certain deficiencies or abnormal conditions in both humans and animals. The specific effects of many of the hormone treatments are rather well known. In a number of other cases the effects of treatments appear to be conditioned by the physiological state of the subject and in many cases the effect of prolonged treatment is not known. In these investigations an attempt is being made to contribute to the knowledge of this very technical field as it applies to cattle.

Stilbestrol, a hormonal product influencing lactation, has been used to stimulate milk production in dry animals. Several dairy cows were treated with this product during the past year, starting with daily doses of 5 mg., which were gradually increased to 20 mg. One cow that had not calved since December 1940 was started on test late in June. Her udder increased in size late in July and in the middle of

August she came into milk; however, milk production never exceeded one pound per day and the rate decreased all during September. Another cow with a poor breeding history since 1934 was successfully bred in the spring of 1943. This cow did not have any udder development as a result of the stilbestrol treatment, and in spite of the treatment there was never any milk in the udder.

Since the production of milk is largely controlled by food intake, observations were made on the effect of stilbestrol on the food intake of rats. A single injection of the product during heat caused a drop in food consumption for a day or two and then during the resulting pseudo-pregnancy there was an increased food consumption and a gain in weight. If stilbestrol injections are given every day for 10 days, there is a consistent depression of food intake and there may be a loss of body weight.

The above results indicate that stilbestrol by itself is not particularly promising. The findings point out the need for more intensive study of the effect of hormones under varying conditions before making recommendations for general use. In addition, body activities are seldom expressed as a result of the action of a single hormone but are a reflection of combined hormonal effects. For example, the depressing effect of injected stilbestrol on food intake may be overcome by the stimulation of appetite produced by a different hormone. Further knowledge of the interrelationships of hormones may indicate valuable uses of hormones in combination.

Crossbreeding Dairy Cattle. In many sections of the country, particularly in the milk sheds around metropolitan centers, crossbreeding of dairy cattle is being practiced quite generally with the purpose of increasing the fat content and likewise the returns of market milk. The crossbreeding is being practiced, however, without any guide for predetermining the qualities of the offspring. This investigation was undertaken to develop a method whereby the desirable qualities of various breeds can be blended and fixed.

Males and females of known producing strains of the Holstein-Friesian, Jersey, Guernsey, and Red Danish breeds were selected for crossing to develop a method for increasing producing ability. Hybrid vigor in relation to size, rate of development, and resistance to disease are likewise studied.

To date, 15 two-year-olds, all the product of two breed crosses, have completed their first lactation periods. Six of the animals were the product of Holstein x Jersey crosses; 3 of Red Dane x Jersey crosses; 3 of Red Dane x Holstein crosses; and 1 each of Holstein x Guernsey, Red Dane x Guernsey, and Jersey x Guernsey.

The increased production attributable to hybrid vigor in these crossbred animals has been measured by the percent by which their production

exceeds the predicted production based on the performance records of their parents and grandparents. The average predicted production of the 15 crossbreds, based on this procedure, was 15,112 pounds of milk, containing 658 pounds (4.38 percent) of butterfat. Their actual average yield was 17,508 pounds of milk, containing 798 pounds (4.59 percent) of butterfat. This represents an increase over the predicted of 15.9 percent in milk yield and 21.3 percent in butterfat yield, which may be attributed to hybrid vigor.

It remains to be determined whether the offspring of these two breed crosses can maintain the increased yield of their dams. Present plans call for the inclusion of a third breed to produce the future offspring to determine if this procedure will maintain or increase the effects of hybrid vigor.

Effect of Cooking on the Nutritive Properties of Potatoes. In order to determine the best methods of cooking potatoes to conserve nutritive value and improve palatability and digestibility, a series of experiments was undertaken with U. S. No. 1 Maine-grown potatoes. The potatoes were stored at 40° F. and 85 percent relative humidity.

Between early November, when the potatoes went into storage, and the middle of January the raw potatoes lost 50 percent of their ascorbic acid content.

Palatability tests made by a panel of trained tasters showed that whole potatoes boiled or baked in their skins and quartered and peeled potatoes cooked in small or moderate amounts of water were practically equal in eating quality. Potatoes boiled whole and unpeeled retained most of their nutritive value. Even the ascorbic acid was almost entirely retained.

As soon as the surface of the potato is exposed, as in the peeled and quartered potatoes, solubility begins to play a considerable part in the loss of nutritive properties. Under the conditions of this experiment, 22 percent of the ash and 17 percent of the nicotinic acid (pellagra-preventive) are leached out into the cooking liquid. Thirteen percent of the ascorbic acid is lost as a result of heat or oxidation, while 11 percent is dissolved into the cooking liquid.

In pressure cooked potatoes the losses are lower due to decreased solubility than in plain boiled potatoes. Mashing and hash browning are definitely less favorable with respect to retention of ascorbic acid than plain boiling. Cooking in a pressure saucepan produced a darkening of the flesh of the potatoes.

The information obtained in this study is used in popular articles, press releases, and radio talks for the benefit of housewives and in the compilation of average food consumption values.

Administration of Payments to States under Title I, Bankhead-Jones Act.

During the fiscal year 1944, the administration of the provisions of Title I of the Bankhead-Jones Act of June 29, 1935, which authorized payments for agricultural experiment stations, involved:

- (a) Critical examination and approval, in advance of the expenditure of funds, of research projects, there being 1,272 active Bankhead-Jones projects during the fiscal year, of which 244 were either new or revised. This represents an increase of 73 in the total number of active projects over the previous fiscal year.
- (b) Review in the field of the work and expenditures at the State agricultural experiment stations under funds totaling \$2,463,708 provided under Title I of the Bankhead-Jones Act and apportioned on the basis of rural population.
- (c) Review in the field of research and research facilities of the stations supported by \$2,463,708 from non-Federal sources advanced as offset credit to meet the requirements of Section 5 of the Bankhead-Jones Act.
- (d) Special examination of any expenditure from the allotments under the Bankhead-Jones Act made for the construction, equipment, and maintenance of buildings and purchase and rental of land to ascertain that such expenditures were necessary for the research supported by the funds provided by the Bankhead-Jones Act.
- (e) Assisting in coordinating the research under this Federal-grant fund between the State stations and with the research of the Department, and maintaining advisory relations with the State stations on technical and administrative matters pertaining to their research programs and station organization.
- (f) Reporting to the Secretary and the Congress on the work and expenditures under this Federal-grant fund.

Specific examples of the type of work done under this project are given below in the statement for the Office of Experiment Stations under the appropriation "Payments to States, Hawaii, Alaska, and Puerto Rico for Agricultural Experiment Stations" and under the subappropriation for administration of grants to States.

PASSENGER-CARRYING VEHICLES

The estimate for the purchase of passenger-carrying vehicles for the Special Research Fund, Department of Agriculture contemplates an increase of \$500 (\$1,100 in 1945, \$1,600 estimated for 1946) for this purpose. The total estimate of \$2,700 will permit (1) the operation and maintenance of 12 and (2) the replacement of 2 vehicles, or 17 percent of the total fleet, at a net cost of \$1,600 when exchange allowances are taken into account. No funds are requested for the purchase of additional vehicles.

Cars operated under the Special Research Fund are used only for essential research activities in areas where other means of transportation are inadequate or nonexistent. In some instances where common carrier travel is not suited to the work, employees are reimbursed at a rate not exceeding 5 cents per mile for the use of personally-owned automobiles. Travel of this sort, however, is a very small portion of the total.

In normal times, when new cars are readily available, experience has shown that it would be more economical to trade in about 25 percent of the total fleet, so as to avoid exceeding an average age of about four years and performance of about 40,000 miles. In view of the emergency situation, however, it is proposed that only two automobiles, which will have an estimated average mileage of 50,000, be exchanged during the fiscal year 1946. One of the cars to be exchanged will be 7 years old and the other will be 6 years old when turned in.

OFFICE OF EXPERIMENT STATIONS

(a) Payments to States, Hawaii, Alaska, and Puerto Rico for
Agricultural Experiment Stations

Appropriation Act, 1945	\$7,001,208
Budget estimate, 1946	7,547,500
Increase	+ 546,292

PROJECT STATEMENT

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
1. Hatch Act (March 2, 1887)....	\$ 720,000	\$ 720,000	\$ 720,000	- -
2. Adams Act (March 16, 1906)...	720,000	720,000	720,000	- -
3. Purnell Act (February 24, 1925)...	2,880,000	2,880,000	2,880,000	- -
4. Bankhead-Jones Act (June 29, 1935)....	2,463,708	2,463,708	3,000,000	+ 536,292 (1)
5. Hawaii Station Act (May 16, 1928).....	90,000	90,000	90,000	- -
6. Alaska Station Act (February 23, 1929)...	15,000	15,000	15,000	- -
7. Alaska Station Act (June 20, 1936) ...	22,500	22,500	32,500	+ 10,000 (2)
8. Puerto Rico Station Act (March 4, 1931)...	90,000	90,000	90,000	- -
Total estimate or appropriation...	7,001,208	7,001,208	7,547,500	+ 546,292

CHANGE IN LANGUAGE

The estimates include a proposed change in language involving deletion of the following proviso:

Provided, That in order to prevent reduced allotments because of changes in relative rural population, \$63,708 of the appropriation in this paragraph under the Bankhead-Jones Act shall be available for allotment during this fiscal year in the same amounts and to the same States and Territory which received allotments from this appropriation in the fiscal year 1942.

The deletion of this proviso relating to the distribution of \$63,708 of the appropriation is proposed in the Budget estimates since authority therefor is now contained in the Department of Agriculture Organic Act of 1944, approved September 21, 1944 (Public Law 425), and its retention in the annual appropriation language is, therefore, unnecessary.

INCREASE

The total increase of \$546,292 in this item for 1946 consists of the following:

(1) An increase of \$536,292 to carry out the provisions of Title I of the Bankhead-Jones Act of June 29, 1935, which authorizes an appropriation of \$3,000,000, the amount recommended, for payments to the State, Hawaii, Alaska and Puerto Rico experiment stations.

Objective: To promote the production, distribution, and utilization of essential food and other agricultural products by providing funds needed to meet increased costs of research by the State, Territorial and Puerto Rico agricultural experiment stations and to permit continuance of this work at the level necessary for effective service.

The Problem and Its Significance: The demands for agricultural products to supply civilian populations and military forces call for continuing research to provide technical information needed for the production and effective distribution and use of agricultural resources under the changing conditions now faced and in prospect.

The State agricultural experiment stations are important factors in the realization of production goals. They have responsibility to carry on research and experimentation directed to the solution of problems of the individual States and for participation with the U. S. Department of Agriculture in developing information contributing to the welfare of the Nation as a whole. Because of their first-hand knowledge of local conditions throughout the United States and through newly acquired facts, the experiment stations have been and are now being called upon to meet many special and pressing needs of farmers during the war period and it is anticipated that these needs will continue and increase in the period ahead.

The problems to be met through station research vary with locality and season, and with shifts in requirements for agricultural products. Greatly expanded demands for food, fibers, oils, and other strategic farm products have brought new problems to the door of the stations for solution. Problems of transporting products and supplies, of best ways of processing and storing, of substitution for critical materials in short supply, and of helping to alleviate farm labor shortages have demanded and received attention. National consciousness of the importance of adequate nutrition for civilians and the armed forces has called for new facts on nutritive requirements and nutritive values of food.

Already farmers are beginning to raise questions for guidance in adjusting production to present and future requirements with renewed emphasis on advancement of the science of farming, on quality and economy in production, conservation of land and other resources, and renewal and restoration of the physical plant. Nutritive qualities in food and feed crops should also receive increasing emphasis.

The State stations should have the financial means available to meet the many new problems arising out of the current situation.

Information at hand relating to costs of conducting research by the experiment stations in 1946 indicates the following status:

(a) Costs of conducting research. Adjustments of expenditures during the war period as compared with immediate prewar years have involved increases in 1944 over 1941 of about \$1,440,000 for personal services, \$1,500,000 for supplies and materials, and \$300,000 for miscellaneous expenditures such as travel, transportation, communication, utilities, and printing. These increased costs have been met by reducing expenditures for equipment by about \$240,000 and for land and structures by \$400,000, and by increasing total expenditures by \$2,600,000, of which \$2,500,000 was derived from State sources.

Increased costs rather than increased purchases account for a rise of about \$1,500,000 in expenditures for supplies and materials.

Beginning with the fiscal year 1943, there has been a marked reduction in expenditures for equipment and lands and structures as compared with the normal expenditures of prewar years, including 1941. For the fiscal years 1943 and 1944, this reduction totaled about \$1,365,000. If continued as indicated by present trends, this will result in a backlog of three years of needs by 1946. Granting that war conditions will limit the amount of restoration practicable, the probability is that increased expenditures will be necessary to maintain equipment and physical plants in working condition.

Costs of personal services in 1944 increased about \$1,440,000 over 1941 due to higher salaries and wages. The men who are in the armed services are on leave with the understanding that their positions will be open to them when they return. Some have already been released from the Army and other war activities. It is expected that additional men will return to their positions by the fiscal year 1946 even with the war continuing. This will necessitate added costs for salaries if the returning personnel is reemployed according to agreement.

(b) Funds available. Preliminary data on funds available to the experiment stations in 1944, as supplied in the justification of budget estimates for 1945, indicated an increase for 1944 over 1943 of at least \$1,000,000 from State sources. The actual figures for 1944 show that instead of an increase in State funds of \$1,000,000, the States contributed approximately \$2,600,000 more in 1944 than in 1943. Preliminary estimates for 1945 show probable finances equal to or slightly greater than for 1944, but not commensurate with the needs.

As indicated previously, the increased costs of the experiment stations in meeting war conditions have been met by increases in funds

from State sources, a considerable part of which has been by State appropriations. The total of funds available to the stations from State sources and Federal appropriations has changed in the following ratio:

	<u>State</u>	<u>Federal</u>
1940	\$2.10	\$1.00
1941	2.27	1.00
1942	2.27	1.00
1943	2.49	1.00
1944	2.85	1.00
1945 (Est.)	2.85	1.00

There has been no increase in the total of Federal appropriations since 1942 except for an increase of \$75,000 in 1944, continued in 1945, which included \$12,500 for Alaska, \$22,500 for Hawaii, and \$40,000 for Puerto Rico.

Authorization: For payments to the States, Hawaii, Alaska, and Puerto Rico for agricultural experiment stations, Title I of the Bankhead-Jones Act of June 29, 1935, authorizes the following appropriations to be apportioned on the basis of rural population: Fiscal year 1936, \$600,000; fiscal year 1937, \$1,200,000; fiscal year 1938, \$1,800,000; fiscal year 1939, \$2,400,000; fiscal year 1940 and thereafter, \$3,000,000. Beginning with the fiscal year 1939, the full amounts have not been appropriated, as shown in the following tabulation of action taken in regard to this item:

<u>Fiscal Year</u>	<u>Authorized by Title I of the Bankhead-Jones Act</u>	<u>Budget Estimate</u>	<u>Appropriation Act</u>
1939	\$2,400,000	\$1,800,000	\$2,100,000
1940	3,000,000	2,400,000	2,400,000
1941	3,000,000	2,400,000	2,400,000
1942	3,000,000	2,400,000	2,463,708
1943	3,000,000	2,000,000	2,463,708
1944	3,000,000	2,463,708	2,463,708
1945	3,000,000	2,400,000	2,463,708
1946	3,000,000	3,000,000	

Total allotments from Title I of the Bankhead-Jones Act to the various State and Territorial agricultural experiment stations as appropriated during the fiscal year 1942 through 1945 and according to the estimate for 1946 are indicated in the following Table I;

TABLE I

ALLOTMENTS TO STATIONS UNDER BANKHEAD-JONES ACT OF JUNE 29, 1935, TITLE I,
AS APPROPRIATED 1942, 1943, 1944, AND 1945, AND BUDGET ESTIMATE 1946

	: Appropriated 1942, 1943, 1944, 1945 (Basis 1940 Rural Population and Proviso in Approp. Act)	: Estimate 1946 (Basis 1940 Rural Population and Proviso in Organic Act of 1944)
Alabama	: \$ 82,695.12	: \$ 100,738.23
Alaska	: 2,252.44	: 2,755.77
Arizona	: 13,285.16	: 16,253.80
Arkansas	: 63,983.20	: 77,832.33
California	: 81,893.64	: 100,193.21
Colorado	: 22,430.96	: 27,291.14
Connecticut	: 22,507.32	: 27,536.72
Delaware	: 5,189.96	: 6,349.66
Florida	: 34,782.16	: 42,554.44
Georgia	: 87,522.92	: 106,231.29
Hawaii	: 9,186.40	: 10,638.40
Idaho	: 14,219.84	: 17,397.33
Illinois	: 86,736.52	: 105,788.75
Indiana	: 62,900.44	: 76,955.90
Iowa	: 64,854.64	: 78,124.80
Kansas	: 50,050.96	: 59,607.11
Kentucky	: 81,533.32	: 99,752.39
Louisiana	: 56,502.80	: 69,128.66
Maine	: 20,692.16	: 25,293.40
Maryland	: 30,259.72	: 37,021.41
Massachusetts	: 18,674.92	: 22,847.91
Michigan	: 73,566.60	: 90,005.45
Minnesota	: 57,269.04	: 70,066.12
Mississippi	: 72,651.40	: 88,630.98
Missouri	: 76,967.80	: 93,614.07
Montana	: 15,503.16	: 18,678.42
Nebraska	: 38,776.60	: 46,093.12
Nevada	: 2,734.64	: 3,345.70
New Hampshire	: 8,507.40	: 10,408.42
New Jersey	: 31,260.32	: 38,245.59
New Mexico	: 14,516.00	: 17,759.70
New York	: 94,478.24	: 115,589.90
North Carolina	: 106,085.56	: 129,790.93
North Dakota	: 24,675.76	: 29,330.32
Ohio	: 93,717.64	: 114,659.33
Oklahoma	: 68,450.84	: 81,745.94
Oregon	: 22,790.32	: 27,882.95
Pennsylvania	: 135,322.64	: 165,561.23
Puerto Rico	: 53,213.24	: 65,104.04
Rhode Island	: 2,449.04	: 2,996.27
South Carolina	: 59,464.96	: 72,549.44
South Dakota	: 24,432.44	: 28,857.61
Tennessee	: 77,136.04	: 94,372.51
Texas	: 149,364.76	: 181,338.55

TABLE I - continued

ALLOTMENTS TO STATIONS UNDER BANKHEAD-JONES ACT OF JUNE 29, 1935, TITLE I,
AS APPROPRIATED 1942, 1943, 1944, and 1945, AND BUDGET ESTIMATE 1946

	: Appropriated 1942, 1943, 1944, 1945 (Basis 1940 Rural Population and Proviso in Approp. Act)	: Estimate 1946 (Basis 1940 Rural Population and Proviso in Organic Act of 1944)
Utah	: \$ 10,503.68	: \$ 12,737.97
Vermont	: 10,471.60	: 12,625.36
Virginia	: 71,144.56	: 86,961.54
Washington	: 33,254.64	: 40,685.56
West Virginia	: 55,859.16	: 68,341.20
Wisconsin	: 60,224.88	: 73,535.25
Wyoming	: 6,759.52	: 8,193.88
Total	: \$2,463,707.08	: \$3,000,000.00

(2) An increase of \$10,000 to carry out the provisions of the Act of June 20, 1936, which authorizes an appropriation of \$32,500 for the fiscal year 1946 for the Alaska Agricultural Experiment Station.

Objective: To provide for investigations by the Alaska Agricultural Experiment Station to improve Alaskan agriculture as authorized by the Act of June 20, 1936.

The Problem and its Significance: The major portion of the food consumed by the population of Alaska has been shipped in from the States for many years. Shortages of cargo space and rail transportation, incident to the present emergency, have increased the normal difficulties of food shipment into the Territory at a time when the permanent civilian population as well as armed forces call for increased agricultural production and improvement in the quality of agricultural products of the Territory, both currently and as a long-time program. This is especially true as to protective fresh foods such as dairy products, eggs, fresh vegetables, and potatoes.

The Alaska Experiment Station is attempting to solve the major agricultural problems of a varied area approximately one-fifth as large as the total 48 States. Research conducted in the States by the State agricultural experiment stations and the U. S. Department of Agriculture is not directly applicable to Alaskan conditions because of wide differences in climate, soils, and other environmental factors. Bureaus of the Department do not conduct studies in Alaska as is done in the States. It is becoming increasingly evident that the successful production of foods and feeds of desirable kinds and of satisfactory quality in Alaska is dependent more and more on the development through research of scientifically sound information on the best crop varieties, how these may be adapted, what are the best planting, fertilization, and cultural practices, including soil adaptation and management for the production of such crops, and how they may best be protected against insects and diseases. Nutrition and general management of poultry,

livestock and dairy production stock must also be put on a scientifically sound basis. Local sources of good seed for important protective food crops such as potatoes are generally lacking. Much of the seed shipped into the Territory from the States frequently is of inferior quality and is suspected as being the means through which some diseases and insects have been brought into the Territory. The experiment station should, therefore, produce limited quantities of good seed of various kinds which farmers can multiply. In line with good principles of balanced nutrition, it is important that more of the protective food crops such as tomatoes and green vegetables be grown in the Territory and that scientifically sound information be secured regarding varieties, culture, and management to assure a satisfactory measure of success in their production.

These and other new problems such as the control of insects which destroy alfalfa and other hay and pasture crops as well as food crops are typical of the food and feed production problems confronting the station. Cutworms, for example, have been found to be highly destructive of hay and forage crops which are vitally needed in livestock and dairy production, and root maggots have been especially destructive of some of the more important vegetable crops. The fact that 10 or more species of cutworms are involved in the pasture insect troubles, some of which are destroyed and others appear to be encouraged by specific control measures, would indicate the complexity of the insect problem and the necessity for the most skillful type of trained scientific attack on this problem.

The Alaska experiment station has been attempting to serve the agriculture of the Territory with very limited financial support. This effort is being continued in the face of appreciable increases in operating costs not only due to the rapid rise in prices but to the fact that satisfactory solution of the type of agricultural problem at present confronting the station calls for more specialized scientific personnel. For example, the insect problem has necessitated the employment of a highly trained research entomologist. The importance of food plant improvement has necessitated the employment of a highly trained plant breeder who has special knowledge of important food crops such as potatoes and tomatoes. There is increasing need for a highly trained soil-plant scientist to cope with new problems of soil maintenance and plant production as a result of continuing cultivation.

Work began last year on some of the new problems of control of vegetable and forage crop insects. Under the leadership of the research entomologist, some of the more destructive insects for certain forage and vegetable crops have already been identified and preliminary control measures for some species of destructive cutworms have been developed. Progress made in new efforts to introduce and improve potato varieties looks promising and evidence is accumulating as to the possibility of growing some of the protective food crops

such as tomatoes in the Territory. Another winter of successful maintenance in production and in reproductive capacity of dairy cows, sheep, and hogs, fed on various combinations of locally produced feeds such as oat-pea hay, oat-pea silage, cull peas, fish meal and others has added to the evidence that satisfactory livestock feeds may be produced locally which are considerably cheaper than imported feeds.

Greater scientific prevision in this work is imperative, however, if needs for improved food and feed crops, better crop protection and more and better livestock products are to be realized on a permanent basis. The station is endeavoring to accomplish this objective and is attempting to employ well trained specialists for the purpose. The authorized increase of \$10,000 can well be used in this manner.

The work program of the Alaska experiment station is carried on at three locations to meet the varied conditions of the Territory. Major use of the Federal-grant funds and practically all attack on problems of human food and livestock feed production are at the Fairbanks and Matanuska stations.

Authorization: The Alaska Station Act of June 20, 1936, extends to Alaska the benefits of the Adams and Purnell Acts and authorizes appropriations beginning at \$5,000 in 1937 and increasing each year until 1947 when the authorized appropriation is \$37,500, which is one-half of that provided for each State under the Adams and Purnell Acts. The following tabulation indicates the amounts authorized and appropriated beginning with the fiscal year 1939:

<u>Fiscal Year</u>	<u>Authorized by Act of June 20, 1936</u>	<u>Budget Estimate</u>	<u>Appropriation</u>
1939	\$10,000	\$10,000	\$ 8,750
1940	12,500	10,000	8,750
1941	15,000	10,000	10,000
1942	17,500	10,000	10,000
1943	20,000	10,000	10,000
1944	22,500	22,500	22,500
1945	27,500	22,500	22,500
1946	32,500	32,500	

WORK UNDER THIS APPROPRIATION

Responding to unprecedented demands for information during the war, the State agricultural experiment stations have focused their research on the most urgent problems of the States and localities within the framework of national needs and programs. Significant facts on many new problems have been sought and obtained in the least possible time commensurate with sound results. These facts have been blended with the cumulative findings and practices of a half century of agricultural science to form a body of information which farmers have applied in producing the greatest volume of food in the history of the Nation. Except for the timely aid of research facts, production might have fallen far short of needed goals.

New studies were undertaken by the stations in 1944 to help solve emergency problems under a total of 641 new and revised projects supported by the Federal-grant funds. In all, 3,484 Federal-grant research projects were active during the year. Many projects continued from 1943 had already yielded important information which had been released promptly for maximum service, but other phases of the problems required additional study. A number of studies, some confidential in character, had direct application to problems of importance to the armed forces. Many were cooperative with the Department under formal memoranda of agreement.

Among Nation-wide undertakings in 1944 were studies by virtually all stations in cooperation with the Department and State agencies as to farm production possibilities in 1945 for the States by localities. Similar studies in 1943 and 1944 furnished part of the data on the basis of which production goals and other national programs were established.

Important progress was made under the national cooperative project dealing with the conservation of nutritive value of foods. A group of stations participated in a special study of losses of vitamins in the preparation, cooking, and servicing of food in Army and Navy training camps at land-grant institutions.

By the end of the year, data were being assembled from 20 State stations in cooperation with the Agricultural Research Administration, Bureau of Dairy Industry, on the amount of vitamin A supplied by creamery butter. The data obtained during the four seasons from various areas in the participating States will serve as a national guide in making provision for adequate amounts of this essential vitamin.

Only brief mention by way of example can be made of a few of the new research studies begun by the stations in 1944 to solve local problems.

Increased feeding of poultry to produce the large volumes of meat and eggs needed in wartime and diversion of former supplements to human use has led to shortages of proteins and vitamins required in poultry rations for greatest efficiency. The Eastern Regional Research Laboratory had determined that dehydrated wastes of the vegetable canning industry contain large amounts of carotene and riboflavin. Accordingly, the Delaware station undertook feeding trials of several kinds of dehydrated wastes prepared by the laboratory. Mashs containing 8 percent of such material fed

to broilers gave a rate of growth equal to a mash containing alfalfa meal and were more palatable. A broccoli-leaf meal was especially outstanding in promoting vigorous growth and in the fine flavor of the meat. Thus, through this cooperative research a new source of needed supplements has been found for the poultry farmer and a new use for large quantities of wastes that occur in producing and processing vegetables for canning.

Along similar lines the Maine station found within the year that dehydrated Ladino clover meal is an excellent substitute for alfalfa leaf meal in poultry rations. As a result Maine pountrymen in the future may use homegrown Ladino products.

The high waterproof qualities and buoyancy of milkweed floss has led to its wide-scale use in lifebelts and airmen's jackets in place of kapok. A study begun by the Michigan station in cooperation with the Department and the University of Michigan should provide a foundation for the commercial culture of milkweed through the discovery and development of high-yielding strains having valuable properties of floss. One type superior in floss production has already been isolated.

New facts on how to obtain maximum benefit from fertilizers, including best ways of using manure, legumes, and rotation practices, have helped to boost soil productivity.

Higher yields and better quality of products have resulted through the release to farmers of many new and improved varieties of crop plants, developed by the stations often in cooperation with the Department.

Important progress has been made in developing better control methods for diseases and insect pests, including more effective fungicides and insecticides. New pests and diseases have been studied and leads toward future control developed.

Needed supplies of meats, milk, and other animal products have been maintained at high levels through the aid of new research information pointing the way to maximum use of forage crops, higher yields of feed grains and ways of substituting for grains in short supply, best uses of limited supplies of protein, meeting vitamin and mineral requirements, and avoiding losses from diseases, parasites, and pests.

The production of both food and feed has been aided by development at the stations of labor-saving equipment of simple design for construction on the farm from spare parts or noncritical materials.

New facts on methods of preserving foods, especially dehydration, and problems of storage, particularly under the extremes of conditions under

which food for the armed forces is shipped and stored abroad, have helped to insure maximum use of foods produced.

Continued research on the supply and demand for farm labor, on problems arising out of limited facilities for transporting farm products and supplies, and on costs of production has provided much detailed information for use by farmers and State and Federal agencies concerned with problems of this character.

Information dealing with the research programs, results, and services of the agricultural experiment stations has been assembled during the year and released as mimeographed reports to the directors, and to administrative officers of the Department.

Total amounts available to the various State and Territorial agricultural experiment stations from both Federal and non-Federal sources during the fiscal year 1944 are indicated on the following Table II.

- 55 -
TABLE II - Funds Available to Stations, Fiscal Year 1944

Station	Federal	Non-Federal	Total
Alabama	\$172,695.12 :	\$848,660.07 :	\$1,021,355.19
Alaska	39,752.44 :	40,855.44 :	80,607.88
Arizona	103,285.16 :	154,073.69 :	257,358.85
Arkansas	153,983.20 :	240,356.02 :	394,339.22
California	171,893.64 :	1,483,704.99 :	1,655,598.63
Colorado	112,430.96 :	294,265.62 :	406,696.58
Connecticut, State	56,253.66 :	150,840.28 :	207,093.94
Connecticut, Storrs	56,253.66 :	72,491.21 :	128,744.87
Delaware	95,189.96 :	142,216.41 :	237,406.37
Florida	124,782.16 :	867,897.53 :	992,679.69
Georgia	177,522.92 :	172,051.12 :	349,574.04
Hawaii	99,186.40 :	152,815.95 :	252,002.35
Idaho	104,219.84 :	101,180.33 :	205,400.17
Illinois	176,736.52 :	617,297.00* :	794,033.52*
Indiana	152,900.44 :	982,603.04 :	1,135,503.48
Iowa	154,854.64 :	631,669.17 :	786,523.81
Kansas	140,050.96 :	394,585.64 :	534,636.60
Kentucky	171,533.32 :	576,893.07 :	748,426.39
Louisiana	146,502.80 :	330,671.31 :	477,174.11
Maine	110,692.16 :	171,918.30 :	282,610.46
Maryland	120,259.72 :	227,393.70 :	347,653.42
Massachusetts	108,674.92 :	193,017.35 :	301,692.27
Michigan	163,566.60 :	282,273.97 :	445,840.57
Minnesota	147,269.04 :	491,846.05 :	639,115.09
Mississippi	162,651.40 :	419,531.66 :	582,183.06
Missouri	166,967.80 :	273,021.18 :	439,988.98
Montana	105,503.16 :	272,449.86 :	377,953.02
Nebraska	128,776.60 :	253,178.04 :	381,954.64
Nevada	92,734.64 :	21,647.77 :	114,382.41
New Hampshire	98,507.40 :	32,636.48 :	131,143.88
New Jersey	121,260.32 :	591,541.59 :	712,801.91
New Mexico	104,516.00 :	115,432.20 :	219,948.20
New York, Cornell	166,030.40 :	869,285.97 :	1,035,316.37
New York, State	18,447.84 :	396,127.64 :	414,575.48
North Carolina	196,085.56 :	249,183.62 :	445,269.18
North Dakota	114,675.76 :	151,214.22 :	265,889.98
Ohio	183,717.64 :	1,666,691.40 :	1,850,409.04
Oklahoma	158,450.84 :	431,429.66 :	589,880.50
Oregon	112,790.32 :	420,016.39 :	532,806.71
Pennsylvania	225,322.64 :	335,439.00 :	560,761.64
Puerto Rico	143,213.24 :	216,499.49 :	359,712.73
Rhode Island	92,449.04 :	25,243.18 :	117,692.22
South Carolina	149,464.96 :	487,194.10 :	636,659.06
South Dakota	114,432.44 :	132,996.34 :	247,428.78
Tennessee	167,136.04 :	180,479.51 :	347,615.55
Texas	239,364.76 :	1,131,974.08 :	1,371,338.84
Utah	100,503.68 :	123,161.71 :	223,665.39
Vermont	100,471.60 :	30,969.82 :	131,441.42
Virginia	161,144.56 :	161,839.91 :	322,984.47
Washington	123,254.64 :	354,149.40 :	477,404.04
West Virginia	145,859.16 :	176,564.17 :	322,423.33
Wisconsin	150,224.88 :	666,690.00 :	816,914.88
Wyoming	96,759.52 :	130,946.14 :	227,705.66
Total	7,001,207.08 :	19,939,111.79 :	26,940,318.87

* Estimated

(b) Administration of Grants and Coordination of Research with States

Appropriation Act, 1945	\$176,169
Budget estimate, 1946	<u>153,600</u>
Change for 1946:	
Overtime decrease	-22,497
Other decrease	<u>-72</u>
	<u>-22,569</u>

PROJECT STATEMENT

Project	1944	1945 :(estimated):	1946 :(estimated):	Increase or decrease
1. Administration of Federal grant funds for State and Territorial agricultural experiment stations; coordination of research work of the State and Territorial stations, and coordination of this research with that of the Department and administration of Department insular stations	\$145,559	\$153,672	\$153,600	-\$72 (1)
2. Overtime costs	21,670	22,497	--	-22,497
Unobligated balance	2,707	--	--	--
Total estimate or appropriation	\$169,936	\$176,169	\$153,600	-\$22,569

DECREASE

(1) The total decrease of \$22,569 in this item for 1946 consists of \$22,497 for overtime, and a decrease of \$72 to "round off" the appropriation total.

WORK UNDER THIS APPROPRIATION

Objective: The Office of Experiment Stations (a) represents the Department in the administration of the Acts of Congress authorizing appropriations for the support of State and Territorial agricultural experiment stations in the several States, Hawaii, Alaska, and Puerto Rico (Hatch Act, Adams Act, Purnell Act, and the Hawaii, Alaska, and Puerto Rico Station Acts); and (b) administers the Federal Experiment Station in Puerto Rico.

Plan of Work: Administration of the Acts granting funds to States and Territories involves supervision of the funds, close advisory relations with the stations as to research for which the funds are expended, annual examination of the work and expenditures of each station, assistance to the State stations in working out programs for cooperative effort to

avoid duplication, assistance to Federal agencies in working out cooperation with the States, and preparation of the annual report to Congress on the work and expenditures of the stations, as required by law.

The Federal funds paid to the States and Territories are largely expended on research projects submitted to the Office of Experiment Stations for advisory suggestions and approval in advance of expenditures. Programs of projects with proposed expenditures under the Federal funds are submitted by each station for review and approval at the beginning of each fiscal year. Changes and adjustments in work to best meet State needs are submitted throughout the year.

To carry out the provisions of the Federal Acts, a representative, or representatives, of the Office visits each of the 50 State stations at least once annually and spends four to twenty-one days reviewing the expenditures and the research under way. In addition, staff members cooperate as specialists with individual stations and regional groups in the development and adjustment of research programs for special fields.

As explained under the heading "Special Research Fund, Department of Agriculture," the Office also has the responsibility for the administration of the payments to States authorized by Title I of the Bankhead-Jones Act of June 29, 1935.

Examples of Progress and Current Program:

As in previous years, the Office of Experiment Stations has continued to maintain close advisory relationships with the State agricultural experiment stations on adjustments in their research programs to concentrate on research problems needing immediate solution because of war conditions. A large percentage of these problems are specific and as a result are of a relatively short-term duration. This is evidenced by the fact that of the total of 3,484 studies undertaken during the fiscal year 1944, 483 were under new projects; 158 projects were revised; and 708 projects were completed or discontinued. Each revised project and each project continued without change was reviewed during the year by the staff of this Office as to intent, adequacy, and progress. Any problem of more than local interest was reviewed in cooperation with other agencies concerned for correlation of the research with work being conducted by other State stations or by other agencies so as to avoid duplication of effort and to promote accurate research results through cooperative and joint attack on problems extending beyond the boundaries of any one State. The extent of this cooperation is indicated by the 1,190 formal cooperative memoranda of

understanding in effect during the year between State stations and between State stations and other agencies. Each of these memoranda of understanding was approved by the Office of Experiment Stations before becoming operative.

As indicated in the statement under the Federal Experiment Station in Puerto Rico, which follows several pages later, the research program has been aimed at participation in the important problems of securing strategic materials, especially insecticides and quinine; at assistance in the problem of increasing food production in Puerto Rico; and at aiding the armed forces in Puerto Rico through making available planting materials not readily available from any other sources.

The Office worked with agencies of the Department and all State experiment stations in arranging for the assembling, review, appraisal of data, including results from experimental work, which was needed in connection with the establishment of production goals in total and allocation by crops and production areas. Participation of the stations involved adjustments in the Federal-grant fund as well as State fund programs at the State stations.

The shortage of legume and grass seeds called for a special program of increased production in 1944 to provide for hay and pasture seedings to meet, if possible, the needs in 1945. The Office cooperated with the Seed Production Committee of the Department and with the War Food Administration in arranging for help on this special program on the part of State station directors and their staffs.

Upon request of the War Food Administration, the Office arranged with a few State experiment stations for additional, immediate studies and feeding trials to obtain more facts relative to the feed value of potatoes for different kinds of livestock. The purpose was to meet feed problems in localities where potatoes may be available and other customary feeds not available or in short supply.

Necessary restrictions on sale of corn for livestock feed in 1944 brought requests to the Office from State experiment stations to assist in obtaining corn for continuation of livestock feeding experiments under way in the interest of war food problems. In cooperation with a special Corn Committee of the War Food Administration, needed information was assembled and the stations were provided with corn to meet minimum requirements in order to secure reliable data from the more essential studies in progress.

Questions and problems relating to dehydration of foods continued to be of importance. A list of projects of all State experiment stations relating to dehydration of foods was assembled for use by the State experiment

stations. This list was supplemented for experiment stations where dehydration research is in progress by a collection of progress reports covering methods and results of research by British laboratories in the dehydration of foodstuffs.

In a similar way, assistance was rendered to the State experiment stations by the Office in bringing together a list of currently active research projects dealing with soybeans, including edible soybeans and soybean products.

Upon request of the State experiment stations, the Office continued to render over-all assistance and coordination for the cooperative studies on the conservation of the nutritive values of foods in processing, marketing, storage, and cooking. This national project, as previously reported, was undertaken upon recommendation of the Committee on Food and Nutrition of the National Research Council. Forty-eight State experiment stations are participating in securing information on about 75 different foods. The information is of immediate service to those responsible for the food supply of our armed forces. It is of both immediate and long-time value to agriculture in meeting increasing interest and demand for high nutritive quality in foods. The Chief of the Office, by request, acts as coordinator in the planning and organization of this cooperative study.

In a similar way, the Office participates in a study, recommended by the Committee on Food and Nutrition of the National Research Council, and now under way actively at 20 State experiment stations and the Department, to determine the extent to which butter in the usual trade channels can be depended upon to furnish a uniform supply of vitamin A and in what amount. Information currently acquired is of immediate use to consumers and to producers.

Throughout the year the Office again continued to assist the State experiment stations through information and negotiations in Washington relative to obtaining urgently needed equipment, materials, and supplies.

Assistance was continued in arranging contacts of representatives of other countries with State experiment stations and in meeting requests of other countries for publications and information.

The work load along the above and other similar lines as a result of war emergency conditions required a considerable amount of time on the part of all staff members. This assistance saved time, travel expense, and worked for effectiveness of other agencies concerned.

(c) Federal Experiment Station, Puerto Rico

Appropriation Act, 1945	\$107,074
Budget estimate, 1946	<u>160,000</u>
Change for 1946:	
Overtime decrease	-7,699
Increase	<u>+60,625</u>
	<u>+52,926</u>

PROJECT STATEMENT

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
1. Federal Experiment Sta- tion, Puerto Rico	99,260	99,375	160,000	+60,625 (1)
2. Overtime costs	8,095	7,699	- -	-7,699
Unobligated balance	719	- -	- -	- -
Total estimate or appropriation	108,074	107,074	160,000	+52,926

INCREASE

The net increase of \$52,926 in this item for 1946 consists of a decrease or \$7,699 for overtime and

- (1) An increase of \$60,625 to cover construction of needed facilities at the Federal Experiment Station in Puerto Rico.

Objective: To construct seven new dwellings to replace existing houses which are unsafe for further occupancy, an incinerator for disposing of diseased plant and other material, and a headhouse for the greenhouse unit at the Federal Experiment Station in Puerto Rico.

The Situation and Need: It is contemplated that the seven new dwellings will replace seven of the present dwellings which are in need of complete overhauling. All but one of these dwellings, which are occupied by members of the technical staff, were constructed prior to 1925. The dilapidated condition of these houses is such that it would be more economical to replace them than to attempt to repair them.

The Puerto Rico station being located in the tropics has many problems of maintaining adequate physical plant facilities not normally found in the continental United States. The station experiences very heavy rains during a portion of the year and extreme heat and dryness during other portions. Earthquakes and high winds, sometimes of hurricane proportions, are not uncommon. Furthermore, all wooden construction of such soft woods as pine is subject to termite damage and to dry rot. Because of this combination of conditions, a new frame house is estimated to need complete overhauling at least once every six years.

The serious state of disrepair which renders some of the present houses unsafe requires that prompt consideration be given to their replacement. Housing facilities must be made available for the scientific staff of the station since a continental American cannot rent, in the City of Mayaguez, a place affording the privacy and sanitation customary in the States. Without proper housing facilities it would be difficult, if not impossible, to recruit a competent technical staff.

In June, 1944, the architect for the Government of Puerto Rico after an inspection of staff houses stated that "in the event of a hurricane, I would recommend that staff members be evacuated from these buildings because they will certainly suffer collapse in part." He further stated "the electrical systems present a fire hazard in the wooden houses * * * the kitchens and baths are substandard * * * pipes and fixtures need replacement * * * the station housing has reached the point where the logical and economical step is replacement and not repair".

In addition, the station has need for a headhouse for its greenhouse unit. The Puerto Rico station has one of the largest collections of tropical plants in the Western Hemisphere. As a result, a large amount of greenhouse work must be conducted. The headhouse for the greenhouse unit is necessary for proper conduct of the greenhouse work.

The station also has need for a well constructed incinerator. There is more or less constant need for disposal of diseased plant material which must be burned to prevent spread of disease. The station also has considerable amounts of garbage and other refuse which require proper disposal for sanitary reasons.

Plan of Work: It is contemplated that the construction of dwellings included in this increase will be performed under contract with a local contractor. The engineer on the staff of the station would be responsible for adherence to contract specifications. The construction of the incinerator and headhouse for greenhouse unit would be handled by force account labor.

CHANGES IN LANGUAGE

The estimates include proposed changes in the language of this item, as follows (deleted matter enclosed with brackets, new language underscored):

Federal Experiment Station, Puerto Rico: To enable the Secretary to establish and maintain an agricultural experiment station in Puerto Rico, including the preparation, illustration, and distribution of reports and bulletins, [and not to exceed \$8,000 for the erection and alteration of buildings, \$107,074] \$160,000, of which \$56,000 may be expended without regard to any limitation on the cost of individual buildings specified in this Act; and the Secretary is authorized to sell such products as are obtained on the land belonging to the agricultural experiment station in Puerto Rico, and the amount obtained from the sale thereof shall be covered into the Treasury of the United States as miscellaneous receipts.

The first change deletes the phrase "and not to exceed \$8,000 for the erection and alteration of buildings" since retention of the limitation is unnecessary in view of the fact that provision for construction, repair, and alteration of buildings is now contained in the 1946 Budget language under the Office of the Research Administrator for all bureaus, offices, and items of the Agricultural Research Administration.

The second change proposes the addition of the phrase "of which \$56,000 may be expended without regard to any limitation on the cost of individual buildings specified in this Act", and is for the purpose of permitting construction of the new buildings at the Federal Experiment Station in Puerto Rico as proposed under the increase of \$60,625 previously discussed.

WORK UNDER THIS APPROPRIATION

Objective: The Federal Experiment Station in Puerto Rico conducts research investigations with a view to locating and improving agricultural crops and practices of value to Puerto Rico and the United States.

General Plan: The activities of the station are centered on problems created, or intensified, by the war. The work of the station is discussed more fully below under the following headings: (a) insecticidal crop investigations; (b) drug crop investigations; (c) food crop investigations; (d) plant introduction and propagation; (e) control of insect pests and diseases; (f) bamboo production and industrialization; and (g) cooperation with the Government of Puerto Rico and other agencies.

(a) Insecticidal crop investigations: Derris root formerly obtained from the Far East and Lonchocarpus root produced in South America have been the World's main source of rotenone, an insecticide toxic to insects but harmless to man and domestic animals.

There is immediate need for increased sources of rotenone, over six million pounds of root having been used in 1942 by the American farmer in the production of food. The availability of large quantities of propagating stock of Derris at the Puerto Rico station afforded an opportunity to make wide-scale distribution of such planting material throughout the Western Hemisphere with the resulting establishment of new plantations to provide a nearby source of rotenone. In cooperation with the Foreign Economic Administration and the Office of Foreign Agricultural Relations, 1,385,927 plants and cuttings were distributed throughout Latin America in the fiscal year 1944.

Clonal studies of new high-yielding material of Derris obtained from Sumatra have indicated rotenone increases up to 100 percent over ordinary commercial material. The propagation and distribution of this high-yielding material is being continued as rapidly as possible.

In addition to work connected with increasing the available supply of planting material, investigations were conducted to find better methods of propagation and to improve cultural practices with this crop.

In an experiment to forward the development of rotenone and rotenoids in Derris, hormones were found deleterious when applied to leafy cuttings and unnecessary in the case of leafless cuttings. At the end of three months, leafy cuttings produced greater quantities of roots and higher yield of rotenone than the leafless cuttings ordinarily used for propagating material. In tests of the effects of moisture on new leafless Derris cuttings, it was found that shade and mulch kept the beds continually wet and induced decay of cuttings. The complete burial of cuttings was found detrimental and the practice of planting with a small portion of the tip exposed was by far the most satisfactory.

The propagation of Lonchocarpus by methods other than rooting of leafless stem cuttings indicated that air-layering of leafy cuttings, and leaf-bud cuttings gave satisfactory results.

Investigations on various varieties of the yam bean, a possible source of rotenone, showed that the plant grew well under Puerto Rico conditions. However, the quantity of rotenone was low and found only in the seed of the plant.

A modification of the red-color value test used in determining rotenone and rotenoid content in plants was developed.

In investigations of other plants of possible insecticidal value, a common tropical plant, "mamey", gave high toxicity to many insects under laboratory conditions, indicating possible uses of the seed and leaves of this plant, at least under local tropical conditions where it is easily obtained and prepared.

(b) Drug crop investigations: Quinine, obtained from the bark of the Cinchona tree, has increased in importance as theaters of war have expanded to the tropical areas of the World. The major source of supply was lost with the occupation of Java by the Japanese. The secrets of cultivation of the plant have been carefully guarded by the Dutch planters and little or nothing was known regarding plantation cultivation.

The work of the Puerto Rico station has been concentrated on the development and selection of high-yielding strains of Cinchona and on the solution of cultural problems. The plant has proved to be one of the most difficult to grow, requiring very careful attention throughout the nursery stage and being specific as to its needs for soil and light. Investigations to date have resulted in the solving of practically all the seedbed and nursery problems and it is now possible to grow unlimited quantities of seedlings with complete assurance of survival through the nursery stage. Areas have been selected in Puerto Rico for the establishment of permanent plantings which are considered to be the most ideal available in the island. It is hoped to maintain and to continue to develop plantings of known high quinine content as a permanent source of seed of such high-yielding strains. These investigations solve problems in the establishment of permanent plantings such as soil requirements, fertilizer practices, cover crops, and improvement in product sought.

In an experiment testing soil mixtures for use in Cinchona seed beds, a mixture of fresh humus, sand, and composted manure, ration 1: 2: 1, gave highly significant increases in growth after six months as compared to humus alone or with combinations of humus and sand.

During the year a total of 12,200 Cinchona seedlings obtained from material collected in the Philippines and flown out just before the Japanese occupation, were sent to Puerto Rico and are being grown in nurseries for later establishment in permanent plantings. In addition, a considerable quantity of seed of high-yielding strains also was obtained. The first extensive permanent plantings of the material grown from seed obtained locally from initial plantings made some years ago, has resulted in the establishment of approximately 1,700 plants in permanent locations in the Toro Negro National Forest.

The results of the investigations being conducted in Puerto Rico are being made available to other government agencies interested in the establishment of Cinchona in the Western Hemisphere.

(c) Food crop investigations: Puerto Rico has been dependent upon the importation of foods from the mainland. Under war conditions, it was imperative that the production of local foods be increased as rapidly as possible. One of the immediate needs of the program was seed supplies of crops known to be adapted to the Tropics.

The Puerto Rico station cooperated extensively in the production of seed for distribution in the food production program. Three crops with which the station had been working experimentally received special attention, namely, U. S. D. A.-sweet corn, a variety developed by the station some years ago; the Seminole variety of soybean, introduced and tested by the station; and various varieties of yams. In the course of the year, 9,162 pounds of U.S.D.A.-34 sweet corn, 3,291 pounds of the Seminole variety of soybean, and 24,610 pounds of yams were distributed for seed to increase production. In addition, a small quantity of the above seeds were supplied to other Latin American countries in conjunction with their food production programs. The military forces throughout the Caribbean area received considerable quantities of all of these seeds for planting in their local gardens to increase available supplies of fresh vegetables for the troops stationed in these areas.

Work on the treatment of soybean seed showed that the use of various fungicides resulted in increases of stand from 10 to 100 percent. The results indicated that the treatment of seed was profitable. The continual need for protein in the diet of tropical peoples makes the growing and consumption of soybeans desirable.

Selections of avocados, introduced many years ago by the station, resulted in the grafting of over 1,500 seedlings of promising varieties on local West Indian stock for testing in various locations of the island. These new varieties are known to fruit during the winter months when native avocados are unavailable for local food supply.

(d) Plant introduction and propagation: The work in connection with plant introductions has been concentrated largely on furnishing planting materials and information on the types of plants needed by the armed forces at the bases being developed in Puerto Rico and the Virgin Islands. Information has been furnished as to planting plans, varieties adapted to particular purposes, planting methods, care of material, and the control of insect pests and diseases.

During the fiscal year 1944, a total of 188,843 plants, exclusive of Derris, were distributed to Federal and Insular agencies and to private individuals for testing purposes. In addition, large quantities of seed and grass sod were distributed. Requests for planting material and exchanges were maintained with the tropical countries of Latin America.

Collections of Hevea rubber seed were made from the plantings available at the station and shipped to the Dominican Republic for planting under the rubber program of the Bureau of Plant Industry, Soils, and Agricultural Engineering, which is financed from State Department funds.

Seed of Aleurites trisperma, a relative of the Tung tree, and a source of bagilumbang oil, was sent to the same bureau for distribution and trial throughout Latin America.

(e) Control of insect pests and diseases: The Puerto Rico Experiment Station is working on many different plants of economic and strategic importance. The successful establishment of these plants is often dependent upon the control of insect pests and diseases which attack them.

Two species of thrips were found attacking young seedlings of Cinchona. The infestation was successfully controlled by the application of a 1 to 800 solution of 40-percent nicotine-sulfate.

Investigations of the damage caused by defoliating insects attacking soybeans showed that the velvetbean caterpillar and the bean leaf webber were largely responsible for the damage. The extent of infestation was reduced considerably by the presence of native parasites and fungi attacking insects. The treatment of soybean seeds with various fungicides protected the seeds from disease and decay and resulted in increased stands up to 100 percent. Treatments with any of these chemical compounds are inexpensive and on the basis of results recorded, the treatment of the seed is not only profitable but advisable in view of present seed shortages.

The station continued to receive requests for introduced parasites and predators which have been successfully established in Puerto Rico and during the course of the year a shipment of 6,500 specimens of a pineapple mealybug parasite introduced from Hawaii some years ago were forwarded to Florida for release. Cooperation with the Bureau of Entomology and Plant Quarantine in the introduction of parasites and predators was continued and shipments of sugarcane borer parasites for release in Puerto Rico were received from Brazil.

(f) Bamboo production and industrialization: Bamboo, for many years one of the chief cheap building materials of the Far East, has never been used extensively in the American Tropics. Probably the main reason for this has been that most of the bamboos grown in the Western Hemisphere were of poor quality for construction purposes and were subject to severe attack by the bamboo powder-post beetle which tended to destroy the wood within a few months after cutting.

As a result of the bamboo furniture industry established in Puerto Rico through the efforts of the Office of Inter-American Affairs and the Puerto Rico Development Company, considerable interest has developed in bamboo as a cash crop for the island.

In cooperation with the Soil Conservation Service, a number of test plantings of bamboo have been made on steep hillsides and on gullied and severely eroded land classified as unfit for cultivation. Previous work along these lines has indicated that bamboo will serve as an excellent erosion control crop and thus unprofitable land may be utilized for the growing of a cash crop.

The station program has been concerned with the introduction of species of bamboo from the Far East and of some 38 species introduced, five show great promise in the development of a bamboo industry in Puerto Rico. With increased propagating materials available, more extensive tests are being undertaken on many phases of production, harvesting, and curing which need study.

More than 17,192 bamboo plants were distributed during the year for trial and to increase plantings to develop products for use in Puerto Rico.

Studies on the propagation of bamboo have shown that cutting material for industrial purposes during the dry season at a time most favorable for this purpose permits use of the remaining root stock for planting material during the subsequent rainy season several months later. Studies on the curing of bamboo to prevent checking and splitting and to minimize the attack of the bamboo powder-post beetle in susceptible species have indicated that water curing as practiced in India does not give highly satisfactory results. A method developed in previous years at the station, known as clum-curing, has proved to be the best method found to date.

In cooperation with the College of Agriculture and Mechanic Arts of the University of Puerto Rico, work has been undertaken on the use of bamboo as a reinforcing material. While initial results have not been too promising, there are indications that bamboo may be successfully used as reinforcing material in floors and in simple farm structures.

(g) Cooperation with Government of Puerto Rico and other agencies: For several years the Government of Puerto Rico has annually appropriated funds for expenditure by the Federal station to make possible close and active cooperation in agricultural research of local importance to the island. This program has been directed principally to work concerned with vanilla, essential oils, spices, and the utilization of bamboo.

Experiments on Chinese ginger have given promising results and yield data would indicate that this crop may be highly profitable to the agriculture of the island. Planting material is being propagated as rapidly as possible and the station has been unable to fill the demands of local farmers for this new crop. The work on spices has been largely

concerned with the propagation of planting material and field testing of various spices as to their adaptation to Puerto Rican conditions. Nutmeg, allspice, and cloves have now been established at the station in good supply and are being studied.

Investigations on vanilla root rot have included methods of soil alteration, nutrient studies, and the effect of sunlight on the incidence of the disease. Superior growth and healthier plants have been obtained where limestone was used in connection with mulching practices. Nutrient experiments have indicated that calcium is unquestionably the most important element in the production of vanilla. Experiments on the curing of vanilla beans have shown that beans killed by scratching with a pin, by dipping in hot water, or by freezing, are superior to beans killed by other methods in resultant vanillin and phenol content of the cured beans.

(d) Special Research Fund, Department of Agriculture
(Allotment to Office of Experiment Stations)

This budget schedule covers obligations under an allotment for administration of payments to States for research under Title I of the Bankhead-Jones Act of June 29, 1935. By decision of the Comptroller General, the amount of this allotment is limited to 2 percent of the Special Research Fund. The details of administration of payments to States are explained more fully under the preceding subappropriation item "(b) Administration of Grants and Coordination of Research with States."

(e) Working Funds (Office of Experiment Stations

This budget schedule covers obligations under advances pursuant to Section 601 of the Economy Act of June 30, 1932 for services performed for the Foreign Economic Administration and the Defense Supplies Corporation for purposes indicated in the following statement of obligations under supplemental funds.

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS
(1944 and 1945 figures include overtime costs)

Item	: Obligations, 1944	: Estimated obligations, 1945	: Estimated obligations, 1946
<u>Special Research Fund, Department of Agriculture:</u>	:	:	:
For administration of payments to States for research under the Act of June 29, 1935	\$22,938	\$22,941	\$21,760
<u>Working Funds, Agriculture, (Office of Experiment Stations): Advances from Foreign Economic Administration:</u>	:	:	:
Harvesting, packing, and shipping <u>Derris</u> cuttings in connection with rotenone production	4,841	- -	- -
<u>Defense Supplies Corporation:</u>	:	:	:
Establishment of source of high-yielding <u>Cinchona</u> seed in Hawaii and Puerto Rico for production of quinine..	356	3,144	4,500
Total, obligations under supplemental funds	28,135	26,085	26,260

PASSENGER-CARRYING VEHICLES

The Office of Experiment Stations at the present time has three passenger-carrying vehicles in operation. These three vehicles have travelled 58,373, 43,075, and 36,586 miles at the present time and will continue to be used by the staff of the Federal Experiment Station at Mayaguez, Puerto Rico, where these cars are located.

Experience has indicated that three passenger-carrying vehicles are necessary for proper operation of the Federal Experiment Station at Mayaguez, Puerto Rico. These cars are required to enable technical staff members to conduct official business at experimental locations throughout the island. The station has use of lands for experimental purposes at several widely divergent locations where different climatic conditions are found. Since one of the vehicles now in operation has travelled 58,373 miles over rough and mountainous roads in Puerto Rico, it is felt that this vehicle, which was purchased in 1938, must be replaced in the fiscal year 1946.

PENALTY MAIL
Section 2, Public Law 364, 78th Congress
(Allotment to Office of Experiment Stations)

	<u>Category 1</u>	<u>Category 2</u>	<u>Total</u>
1945	\$400	\$183	\$583
1946	400	230	630
Change	- -	+47	+47

Category 1 consists of publications sent to research workers in response to specific requests, which include lists of the publications issued by the State Agricultural Experiment Stations, "Experiment Station Record," and "Workers in Subjects Pertaining to Agriculture in Land Grant Colleges and Experiment Stations." Also included in this category are publications mailed by the Federal Experiment Station in Puerto Rico consisting of annual reports and current news bulletins and circulars which are of direct assistance in the improvement of tropical agriculture.

Category 2 consists of the administrative correspondence necessary for carrying on the work and operating functions of the Office; correspondence with the State Agricultural Experiment Stations; and correspondence required in connection with the supervision and operation of the Federal Experiment Station in Puerto Rico.

The increase of \$47 for 1946 is based on a Budget increase of \$546,292 for Federal grant funds to States, involving additional correspondence on approval of State projects, and coordination of these projects with the research work of the Department.

Applicability of Law to the Office of Experiment Stations

The estimate covers the official mailings of the Federal Office of Experiment Stations but does not cover the mailings of the State Agricultural Experiment Stations. This arises from the fact that Sections 2c and 2d of Public Law 364 require each Department, Agency and Independent Establishment to submit estimates for the cost of handling its penalty mail and to deposit in the general funds of the Treasury as Miscellaneous Receipts, amounts equivalent to such costs. The State Agricultural Experiment Stations are not "Department, Agency, or Independent Establishment" of the Federal Government and therefore are not subject to these sections of the Act. The State Agricultural Experiment Stations are, however, required to submit inventory reports of envelopes and other mailing materials to the Postmaster General under sections 2a and 2b, which includes not only each "Department, Agency and Independent Establishment" but also "other organizations and persons."

The State Stations derive their authority to use the free penalty privilege from the Act of March 2, 1887 (7 U.S.C. 1940 edition 365) which states the conditions under which they may use the penalty privilege for mailing of bulletins and reports.

BUREAU OF ANIMAL INDUSTRY

CHANGES IN LANGUAGE

(a) Preamble

The estimates include proposed changes in the language of the preamble as follows (new language underscored, deleted matter enclosed with brackets):

For the employment of persons and means in the District of Columbia and elsewhere, including not to exceed [\$712,955] \$591,004 for departmental personal services in the District of Columbia, for carrying out , independently or in cooperation with public or private agencies, including individuals, the provisions of the Act, as amended, establishing a Bureau of Animal Industry, and related Acts [; and the Secretary, upon application of any exporter, importer, packer, or owner of, or the agent thereof, or dealer in, livestock, hides, skins, meat, or other animal products, may in his discretion, make inspections and examinations at places other than the headquarters of inspectors for the convenience of said applicants and charge the applicants for the expenses of travel and subsistence incurred for such inspections and examinations, the funds derived from such charges to be deposited in the Treasury of the United States to the credit of the appropriation from which the expenses are paid; collect and disseminate information concerning livestock and animal products; prepare and disseminate reports on animal industry; purchase in the open market samples of all tuberculin, serums, antitoxins, or analogous products, of foreign or domestic manufacture, which are sold in the United States, for the detection, prevention, treatment, or cure of diseases of domestic animals, test the same, and disseminate the results of said tests in such manner as he may deem best, and purchase and destroy diseased or exposed animals, including poultry, or quarantine the same whenever in his judgment essential to prevent the spread of pleuropneumonia, tuberculosis, contagious poultry diseases, or other diseases of animals from one State to another] , and for investigations concerned with the livestock and meat industries, as follows:

The first change inserts language covering cooperation with agencies and individuals in carrying out the Bureau's work. Similar language has heretofore been included in several of the subappropriation items. Such cooperation is authorized by basic legislation.

The second change deletes authority (1) to make inspections and examinations at places other than the headquarters of the inspectors, (2) to purchase in the open market samples of tuberculin, serums, etc., and (3) to purchase and destroy diseased or exposed animals. These changes are recommended since provision therefor is now contained in

the Department of Agriculture Organic Act of 1944. It is also proposed to delete unnecessary language referring to the collection and dissemination of information and reports on animal industry and to the quarantine of diseased or exposed animals both of which are covered by basic legislation and need not be repeated in the appropriation act.

The third change inserts language indicating in general terms the investigational work for which the funds appropriated to the Bureau are used.

(b) General Administrative Expenses

Appropriation Act, 1945	\$195,379
Proposed consolidation in the 1946 estimates with:	
"Salaries and expenses, animal industry, Agricultural Research Administration,"	
animal husbandry	-29,000
"Salaries and expenses, animal industry, Agricultural Research Administration,"	
diseases of animals	-24,179
"Salaries and expenses, animal industry, Agricultural Research Administration,"	
eradicating tuberculosis and Bang's disease	-55,000
"Salaries and expenses, animal industry, Agricultural Research Administration,"	
inspection and quarantine	-32,200
"Salaries and expenses, animal industry, Agricultural Research Administration,"	
meat inspection	-47,000
"Salaries and expenses, animal industry, Agricultural Research Administration,"	
Virus Serum Toxin Act	-8,000
Budget estimate, 1946	<u> </u>

This subappropriation item is being transferred to and consolidated with the subappropriations shown above. Similar recommendations are made in the 1946 estimates for all bureaus of the Agricultural Research Administration where such consolidations have not previously been effected. This conforms with action taken by the Committee and the Congress in recent years whereby "General administrative expenses" items have been consolidated with the "subject matter" appropriation items of other bureaus of the Department.

(c) Animal Husbandry

Appropriation Act, 1945	\$899,500
Proposed transfer in 1946 estimates from "Salaries and expenses, animal industry, Agricultural Research Administration," general administrative expenses	+29,000
Total available, 1945	928,500
Budget estimate, 1946	855,000
Change for 1946:	
Overtime decrease, -103,324	
Increase +29,824	-73,500

PROJECT STATEMENT

Project	1944	1945 :(estimated):	1946 :(estimated):	Increase or decrease
1. Swine husbandry investi- gations	\$148,019:	\$134,314:	\$134,314:	- -
2. Sheep and goat husbandry investigations	144,830:	145,439:	159,419:	+\$13,980 (1)
3. Horse and mule husbandry investigations	40,573:	40,285:	40,285:	- -
4. Beef cattle husbandry investigations	178,222:	186,524:	191,068:	+4,544 (1)
5. Dual-purpose cattle husbandry investigations	61,784:	63,695:	63,695:	- -
6. Poultry husbandry in- vestigations	230,337:	248,492:	259,792:	+11,300 (1)
7. Certification of pedi- grees of imported regis- tered livestock	5,279:	6,427:	6,427:	- -
8. Overtime costs	87,493:	103,324:	- -:	-103,324
Unobligated balance	16,963:	- -:	- -:	- -
Total available	913,500:	928,500:	855,000:	-73,500
Transferred to "Salaries and expenses, Office of Information, Department of Agriculture"	+500:	- -:	- -:	
Total estimate or appropriation (1944 and 1945 adjusted for comparability)	914,000:	928,500:	855,000:	

INCREASES AND DECREASES

The net decrease of \$74,500 in this item for 1946 consists of the \$103,324 decrease for overtime, and the following:

- (1) An increase of \$29,824 to provide for personnel needed for continuing important animal husbandry research projects.

The need for additional funds to continue important research projects on farm animals, including poultry, is a direct result of greatly increased maintenance costs which have had to be met by the use of funds heretofore used for personnel services. A considerable part of such funds has accrued due to unfilled vacancies of employees who have entered the armed forces. In order to prevent serious retardation of valuable experimental work and to undertake certain short-time projects required to furnish answers to emergency problems in the livestock field, it is necessary, however, to fill some of these vacancies in the near future. Originally it was thought that many of the servicemen would be returning in 1946 and that these vacancies could be filled by their reinstatement. This is not now predictable, but in any event funds are urgently needed to permit employment of necessary personnel to carry forward important work in 1946.

The positions, all in the field service, cover a range of professional and sub-professional grades and pertain to a wide variety of projects in the animal husbandry research program rather than to any one special job. For instance, there is among these vacancies that of a P-5 Chemist whose duties include the supervision of laboratory work in animal nutrition for beef and dual-purpose cattle, sheep, and swine, with particular emphasis on the nutritive value of feedstuffs and the effects of their composition on the quality of animal products. An illustration of the particular problems which this employee handles is that of utilizing byproducts of the distilleries for animal feeds. The enormous increase of alcohol output from grain mixtures, different from that used ordinarily, has made available large quantities of byproducts. Much difficulty has been encountered in using such byproducts for animal feeding for the reason that these new products are different in composition than the ones which feeders had been using in the past. Very substantial death loss and condemnation of carcasses resulted from the initial use of the new byproducts. The Bureau of Animal Industry was called upon to investigate the problem and has made considerable progress in removing the trouble. The investigations are still current and need more manpower to complete if further losses are to be avoided. Another example of work which comes under this position is that of utilizing certain surplus of various crops which occur from time to time. This year we were asked to determine whether surplus potatoes of the poorer grades could be made into

ensilage or dehydrated for use in livestock feed. Immediate action was imperative because many of the potatoes were on railroad sidings and had to be moved. With our depleted staff it was impossible to do more than a very limited amount of work on the utilization of this particular commodity for animal feeding purposes. As a matter of fact, the potatoes which were made into ensilage cannot be properly studied because the number of chemists is insufficient for the job. Another and more strictly current problem upon which no work could be done with the present staff is that of determining the value of certain vegetable wastes as livestock feed. Very large quantities of such material are available in the vegetable production industry and steps are being taken to make some use of it in a concentrated form as animal feed. Chemical composition, including vitamins, of these materials must be learned and feeding trials must be conducted before any one is in a position to determine whether the product has sufficient merit for offering to farmers, and directions must be developed for use in relation to other feedstuffs.

The above are typical examples of the type of problem and the urgency of continuing work upon them as a service to agriculture. The other positions cover different subject matter, the problems differing in detail but the need for filling them is as critical in their respective field as the illustration cited above.

Efforts have been made to reduce costs in every possible manner. Animal numbers have been held to a minimum, certain record-of-performance procedures have been modified or eliminated entirely, and cheaper feeds have been substituted whenever possible. For instance, the breeding herds have been carried on cheaper roughage such as peanut hay instead of alfalfa - thus greatly reducing hay costs. At the present time, however, peanut or mixed hay prices have reached and surpassed alfalfa hay prices of a few years ago - thus making it impossible to make any significant savings in available funds. The only solution to the problem appears to be that of further reducing valuable herds and flocks of breeding animals and thus losing much of the accumulated benefits of many years of careful work or securing additional funds with which to employ personnel.

CHANGES IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

Animal husbandry: For investigations and experiments in animal husbandry and animal and poultry feeding and breeding, [including cooperation with the State agricultural experiment stations and other agencies, including repairs and additions to and erection of buildings necessary to carry on the experiments (not to exceed \$5,000 for the erection or alteration of any one building), \$899,500] and for cooperation with State authorities in the administration of regulations for the improvement of poultry, poultry products, and hatcheries, \$855,000.

The first change deletes the words "including cooperation with the State agricultural experiment stations and other agencies" since that phase of the work is covered by the language included in the preamble.

The second change deletes the language with regard to repairs and additions to and erection of buildings since a general provision for such expenditures is being proposed for the Agricultural Research Administration under the Office of Administrator.

The third change inserts the words "and for cooperation with State authorities in the administration of regulations for the improvement of poultry, poultry products, and hatcheries" in order that the language, although not essential to authorize the work, may describe as accurately as possible the work done under this appropriation. It is believed that the language "investigations and experiments in animal husbandry and animal and poultry feeding and breeding" is not sufficiently descriptive of the fact that the work includes cooperation with State authorities in the administration of regulations for the improvement of poultry, poultry products, and hatcheries, as authorized by Section 101 (b) of the Department of Agriculture Organic Act of 1944, Public Law 425, approved September 21, 1944.

WORK UNDER THIS APPROPRIATION

Objective: Through research, to develop means of improving the productivity, both in quantity and quality, of our domestic farm animals, including poultry; in cooperation with State authorities, to administer regulations for the improvement of poultry, poultry products, and hatcheries; and to administer the provisions of paragraph 1606 of the Tariff Act of 1930 providing for the certification of purebred animals imported by citizens of the United States for breeding purposes.

The Problem and its Significance: Livestock and poultry products vary greatly in quantity and quality per animal unit. Many losses occur which could be avoided by improved breeding, feeding, and management practices. Although the average productivity of the Nation's herds and flocks has increased many fold in the past half century, strains of animals and methods of feeding which outdo the present average in some cases by one and two hundred percent have been developed. The development of these strains of livestock and of these new principles of feeding repays many times over the research appropriations expended, but such research cannot be done by individual farmers and poultrymen as it is too time-consuming, too costly, and requires far too much pooling of trained talent.

General plan: Investigations include (a) testing the merits of different systems of breeding; (b) developing strains possessing inherent characters for high level of performance; (c) studying the various management factors that tend to keep livestock healthy and reduce losses; (d) determining the fundamental nutritive requirements of livestock; (e) determining the best methods of using feeds to obtain maximum results in growth and reproduction; and (f) studying the effects of the foregoing and of processing upon the quality of meat, eggs, animal fibers, and other livestock products.

Receipts: During the fiscal year 1944, approximately \$91,000 from the sale of livestock and livestock products which had served their purpose for investigational work was deposited to the miscellaneous receipts fund of the Treasury.

Examples of Progress and Current Program: The investigations conducted under this appropriation have been redirected in every way possible to be of maximum assistance in the war effort. It has been possible in many instances to apply the results of research to further the war effort on the food front. Examples of recent accomplishments are given below.

Swine husbandry investigations: The results of an 8-year study on swine type involving stock of small-, intermediate-, and large-type Poland Chinas revealed that heritability of swine type is high enough to permit substantial progress from selection. These findings indicate that shifts in swine type can probably be made faster by selecting breeding animals from herds in which type is more extreme in the desired direction than in a breeder's own herd.

A type of lameness or "locomotor incoordination" that has appeared in various sections of the country results from a characteristic form of nerve degeneration. This condition has been produced experimentally on a normal diet of corn, tankage, alfalfa meal, linseed meal and mineral mixture which has been subjected to heat treatment. It has been found that calcium pantothenate added to the heated basal diet greatly reduces the incidence and severity of the disorder. The further addition of pyridoxine appears to be necessary for full prevention. The quantity of calcium pantothenate effective for protection was 0.5 milligram, and of pyridoxine 0.15 milligram per kilogram

of body weight. Other factors found unnecessary were riboflavin, choline, and niacin. The natural feeds that showed protective value when added to the heated diet fed to 8 weeks old pigs were barley, soybeans and oats, while such feeds as egg yolk and liver in the raw state were rather effective. These results indicate that the rather frequent occurrences of the lameness in growing pigs fed on normal diets of corn with supplements appears to be due primarily to insufficient pantothenic acid.

Experiments were conducted to determine the feeding value in the swine ration of distillers dried grains with solubles made from different grains and grain mixtures in the production of alcohol. These feeds contain rather generous levels of vitamins in the B-complex group, and are rather high in protein content. The dried distillers grains were fed as protein supplements to replace either 3.6 or 7.2 percent of the protein in the diet. Other ingredients were corn, tankage, soybean meal, alfalfa meal, and minerals. Results of these tests showed that rations containing 3.6 percent protein derived from distillers grains with solubles produced daily gains varying from 1.17 to 1.26 pounds daily, with feed consumption per 100 pounds of gain varying from 392 to 425 pounds. When fed at the 7.2 percent level, average daily gains varied from 0.81 to 0.85 pounds daily, with requirements of 508 to 567 pounds of feed per 100 pounds of gain. No significant differences were observed between distillers grains with solubles made from a wheat mash, a corn mash, or a combination of the two grains. Further studies are being conducted to determine the reason for the wide differences between the two levels of feeding.

Work was done to determine more definitely the temperature-time relationship necessary to make inactive the enzymes present in fresh meat. On the basis of results to date, a freezer storage study was begun in which a certain proportion of the samples (pork loin) were heated to the internal temperature of 165° F. to prevent enzymatic changes during such storage. Results to be obtained should throw light on the influence of preheating on the freezer storage behavior of meat.

In research on swine improvement, the determination of a satisfactory, single index of carcass merit has been a perplexing problem. During the year, study was made of the usefulness of percentage values for certain combinations of the more-preferred, higher-priced cuts as such an index, with very promising results. This was particularly true when the 5 cuts--ham, loin, bacon, butt, and picnic shoulder--were included. With the percentages based on final feedlot weight of the hogs, the range in yield of the combination of 5 cuts, among 17 breeds and crosses, was from 42.7 percent to 45.5 percent. This range represents a wide difference in weight of preferred products from hogs of the same weight and feeding but differing widely in breeding.

Sheep and goat husbandry investigations: Improvement of the strains of sheep involved in the program at Dubois, Idaho, where work is conducted in close cooperation with the work of the Bankhead-Jones Regional Sheep Breeding Laboratory, has made encouraging progress during the past year. The use of more rapid methods of determining fineness, uniformity, and percentage of medulation in wool fibers has improved the efficiency of selection of breeding sheep. As a result the strains of Columbia, Targhee, and Rambouillet sheep have shown significant improvement. In the shrinkage studies of the 1943 wool clip from these sheep, involving approximately 38,000 pounds of grease wool, it was clearly demonstrated that the former commercial shrinkage appraisals of wool from this station have been too high. These studies showed that the small sample shrinkage technic developed at this laboratory during the last few years has a workable accuracy in practice. The results of these studies have brought about the application of the technic to field conditions in one of the western States and has resulted in savings to the wool growers of that State on the 1943 clip of over \$1,000,000.

In the search for a means of inducing extra-seasonal breeding in goats it was found that 200 rat units of pregnant mare serum produced ovulation in practically all does at Beltsville, Maryland, but as much as 400 rat units and more did not uniformly produce estrus in these does. As estrus, and not merely ovulation, must be accomplished in order to produce pregnancy the results so far indicate the need for not only determining more exactly the most efficient dosages and the combinations of hormones required to produce estrus in does but also the effect of seasonal variations on hormone action. These results have paved the way for a newly organized and vigorous approach to a solution of this problem which must be accomplished in order adequately to distribute the supply of goats milk throughout the year.

Analysis of accumulated data brought out the fact that mutton could be dehydrated in about 6 hours when ground through the 0.25-inch plate, precooked 70 minutes at a maximum temperature of 212° F., and dried in a 29-inch vacuum in the vacuum rotary machine with the meat temperature not exceeding 160°. As freshly dehydrated product the palatability rating was 3.0 in a scale of 5 to 1. When packed in air or vacuum in tin cans and stored at 70° for 100 days there was little change in the palatability. The biological values and digestive coefficients of the protein of dehydrated mutton ranged within comparatively narrow limits and the averages were similar to those for beef and pork.

Horse and mule husbandry investigations: In a mule project conducted cooperatively with the Mississippi and Tennessee Agricultural Experiment Stations, considerable progress has been made in producing animals for test purposes. Great variation was apparent in growth and development of animals produced by the same jack and out of similar type mares. Market appraisals were made of all offspring to determine the relationship between such values and the sires used and performance of the animals at work. Offspring of certain sires averaged much higher in value than offspring of other sires, indicating that the appraiser saw some common character in such groups which made them more valuable to him. When special performance tests were run on such animals, however,

no relation was found between appraised market values and working performance. This preliminary result indicated that future improvement of mules as work animals must be based on a work performance index applied to the selection of jacks and mares.

A special pelleted feed has been developed for horses working under conditions where weight and space occupied by the feed are important considerations from the standpoint of transportation. Seven teams consisting of one test animal fed pelleted feed and one fed the check ration were used. On the basis of 1,000 pounds body weight the ration of the pellet-fed horses weighed 18 pounds and occupied 0.53 cubic feet of space whereas the check ration weighed 23 pounds and occupied 1.11 cubic feet of space. Under the working conditions of the test horses this pelleted ration is considered entirely satisfactory.

Digestion trials made on a series of rations differing only in the fiber content demonstrated a marked increase in efficiency of utilization of the other nutrients in the ration as the fiber level was decreased. With rations having a fiber content of 25 percent (supplying hay at a level of 1 percent of body weight) there was an average total digestibility of 56 percent. When the fiber content was decreased to 17 percent (with hay at a level of only 0.4 percent of body weight) digestibility was increased to 69 percent. When fiber was reduced to 9 percent (no hay) the digestibility was increased to 79 percent. In this experiment the digestibility of ground and cut hay was found to be the same.

Beef and dual-purpose cattle husbandry investigations: In a sire testing program with Hereford cattle, six sire groups were tested by individual feeding of their steer calves. The steers from one of these sires were approximately 150 pounds heavier at marketing time than those of the same age by the other sires. The continued selection of sires on the basis of such performance tests and the use of a low intensity of inbreeding are bringing about significant improvement in the breeding quality of these cattle. The same principles are applicable to all other breeds of beef cattle.

In studies of beef characteristics as influenced by breeding, comparisons were made of steer progeny from nine Hereford sires representing eight lines of pure breeding and a Hereford x Shorthorn x Angus cross. Grade of carcass for the nine groups of steers ranged from low good to choice, the crossbred group ranking highest. The progeny of three sires had values for thickness of external fat--an excellent index of finish--that made them outstanding in this respect. In area of cross-section of "eye" muscle, which was used as an indicator of the development of muscle (lean meat), there were several important differences between sires. These, with other similar results, give promise of leading to the establishment of lines of breeding having superior carcass qualities that will be extremely useful in the post-war period.

Forest range experiments conducted in the Southeastern States in cooperation with the Forest Service have dealt with the benefits derived from the use of experimental feeds during winter months for the cow herd, the effect of periodic burning of the forest stand, and the value of the forage for cattle, the effect of logging and the degree of use of the forest land on grazing capacity, and methods of grazing native reeds where this plant makes up the predominating vegetation. Thus, there is a wide range in the problems to be answered in planning improved production practices for these forest ranges. In the case of experimental feeding of cow herds maintained on the range, beneficial effects have been found in the increased calf crop from the use of as little as 2 pounds per head daily of protein concentrate for a few months during midwinter. One of the very interesting outgrowths of this winter-feeding work has been the high value found for chopped sugarcane. This feed, which can be preserved very simply in the field by cutting and shocking, has been found to be approximately equal to good-quality peanut hay and considerably superior to cottonseed hulls as a supplemental roughage feed. Among the factors which add to the high value of sugarcane as a source of roughage for cattle feeding is the fact that the crop yields a heavy tonnage per acre in the South and Southeast.

In view of the widespread interest in preservation of meat by freezing and the prospective post-war development along this line, research was continued on the freezing and freezer storage of beef and other meats. Results showed that during the subsequent thawing of beef the loss from "drip" decreased with the reduction of freezing temperatures from $+18^{\circ}$ to 0° , -10° , -40° , and -114° F. Increase in the proportion of moisture frozen within the muscle fibers and in the rupturing of the fibers, permitting the proteins to reabsorb more of the water originally frozen in the meat, were believed to be the cause. This reason supplements others previously determined for using relatively low temperatures of freezing.

Poultry husbandry investigations: A principal purpose of research with poultry is the development of methods of breeding and feeding which will increase efficiency of production. The average civilian consumer ate about 3 dozen more eggs and about 5 pounds more poultry during the year than were eaten during prewar years. In order to maintain this higher civilian consumption or to increase it, and thus to maintain producer income and contribute to better nutrition, ways must be found through research to further reduce the cost of producing eggs and poultry meat.

Research on breeding methods for use in obtaining high average egg production is based on the proven technique of selection of breeding individuals on the performance of the family to which they belong. Mating of unrelated family-selected individuals of the same breed and variety has been shown to produce pullet offspring year after year which lay about 200 eggs each under the feeding and management conditions of the Agricultural Research Center, Mating of family

selected outbred individuals of different breeds or varieties has yielded pullet progenies varying in egg production according to the breeding quality of the parental families. Mating of one Single Comb Rhode Island Red male from an outstanding family with highly selected Barred Plymouth Rock females produced pullets which averaged about 240 eggs each. Crossbred progeny from matings of inferior purebred families of different breeds generally yield inferior progeny.

Breeding research with turkeys showed that breast fleshing, weight at 24 weeks of age, and shank length, all important factors affecting market quality, are dependent on heredity. Data from the progenies from first and second filial and back cross matings among Beltsville Small White and Broad Breasted Bronze strains of turkeys showed sufficient correlation between genotype and phenotype with respect to the characters studied to assure progressive improvement through selective breeding based on mass selection. Improvement in market quality of turkeys generally should result from the application of these findings especially since they are applicable by breeders without trapnesting facilities.

A study was completed of the effect of feeding certain fish products on the odor and flavor of roasted turkey and led to the following conclusions: (1) Fish oils of all kinds should be omitted from the diet of turkeys from 8 weeks of age until marketing, but if it is necessary to feed fish oils the quantity should be restricted to 1/8 percent or less of the total diet; (2) only good quality sardine and tuna fish meals should be fed to market turkeys beyond the age of 8 weeks. When one or both of these meals are fed, the quantity should be limited to 5 percent or less of all mash-growing diets, to 8 percent or less of growing mashes that contain 20 to 22 percent protein, and to 12 percent or less of the mashes that contain 32 percent protein.

Research on hatchability during the year has established that air pressures much lower than those encountered during any air transportation may be applied to eggs before incubation without affecting hatchability. Air transport may help to increase the rate and area of distribution of hatching eggs from superior breeding stock.

Investigations have been undertaken to determine the effects of controlled lighting on reproductive processes in the hen, with particular reference to the manner in which such effects are mediated through the anterior pituitary gland. Highly suggestive evidence indicates that the hour of onset of darkness, under the conditions of usual lighting practice, is a major factor in determining the hour of ovulation of the first follicle of the clutch sequence, thus accounting for the orderly behavior of at least one element in the composition of the clutch. The results of other tests indicate that in the absence of both the ruptured follicle and maturing follicles, the eventual lay of eggs thus caused to be retained in the oviducts becomes dependent upon some hormonal factor which in turn is under the control of the lighting schedule to which the hen is subjected.

Shortages of feeds because of the war have resulted in the search for new feedstuffs and better methods of utilizing usual feedstuffs. De-fluorinated rock phosphate was found to be a usable substitute for bone meal made scarce by lack of shipping facilities. Inorganic phosphates are suitable in proportion to the solubility in dilute mineral acid, and in inverse proportion to their fluorine content. Various mixtures of alfalfa leaf meal, dried whey, butyl fermentation solubles, fish meal, meat scrap, and peanut meal proved satisfactory as substitutes for dried skim milk in a high quality starting and growing mash. Soybean oil meal was found to be capable of serving as sole protein supplement in diets for growing chickens provided it was fed at a level which supplied at least 14 percent of crude protein to the diet and provided it was adequately supplemented with vitamins and minerals. Experiments with several possible substitutes for the alfalfa meal in diets of this type indicated that several types of ground hay were not particularly satisfactory but that dried cow manure and dried rumen contents were superior to alfalfa meal and equal to a combination of alfalfa meal and fish meal. Sardine fish meal was found to have outstanding value as a supplement to diets high in soybean oil meal. Starfish meal fed as 2.5 and 5 percent of the diet was also a satisfactory supplement. Diets containing soybean oil meal as the only protein supplement were found to be as satisfactory for the production of turkeys as diets containing dried skim milk, meat scrap, and fish meal. Dried cow manure was an excellent substitute for alfalfa meal in turkey diets. Although analyses of coffee grounds indicates that they might serve as an energy source for chickens, they were found to have a detrimental effect on growth even when fed at a level of 5 percent.

The National Poultry Improvement Plan, initiated in 1935 through the voluntary action of breeders and hatchery men, has contributed greatly to increased efficiency of farm poultry production. Adoption of sound breeding methods and measures for pullorum disease control provided through the plan, with accompanying improvement in feeding and management, have increased average egg production per hen by about 2 dozen eggs during the past 10 years. Participation in the plan has increased as shown in the following table so that about 40 percent of all chicks were produced in hatcheries operating under the plan during the past fiscal year. Many noncooperating hatcheries have adopted practices similar to those of the plan for flock improvement and pullorum control.

Item	:Extent of participation during years ending 6/30			
	: 1936	: 1940	: 1943	: 1944
	: (Number)	: (Number)	: (Number)	: (Number)
States	34:	44:	44:	45
Hatcheries	1,017:	2,192:	2,729:	3,078
Egg capacity of hatcheries	38,066,000:	90,578,718:	149,426,834:	1/189,669,121
Breeding flocks	23,813:	50,559:	69,569:	81,240
Breeding birds	3,522,409:	10,714,238:	16,534,458:	20,218,265
Breeding birds tested:	:	:	:	:
for pullorum disease:	2,053,159:	8,990,869:	15,900,011:	20,218,265
U.S.R.O.P. 2/	:	:	:	:
flock owners	3/	335:	326:	317
U.S.R.O.P. flocks ..	190:	429:	435:	442

Item	Extent of participation during years ending 6/30			
	1936	1940	1943	1944
	(Number)	(Number)	(Number)	(Number)
Birds entered in	:	:	:	:
trap-nest flocks	66,547	144,447	151,685	158,290
U.S.R.O.P. breeding	:	:	:	:
pens	3/	2,429	3,261	3,466
Females in U.S.R.O.P.	:	:	:	:
pens	3/	32,949	45,964	49,040

1/ Represents approximately 1/3 of the total egg capacity of the hatcheries of the country.

2/ U. S. Record of performance.

3/ Complete information not available.

Analysis of production records of 60,683 pullets trap-nested on U.S. Record of Performance farms during the 1941-42 trapnest year shows that the hen-housed average production was 176 eggs per bird. This is an increase of 5 eggs per bird over the previous year. In cooperation with the U.S.R.O.P. breeders and with other breeders with stock of equal private record the Bureau has advised the use of superior sires on hatchery supply flocks. In 1943 reports from 23 States indicated the use of U.S. Certified and U.S.R.O.P. males or of males of equal private record on 18.8 percent of the hatchery supply flocks. In 1944 reports from 17 States indicate use of males of this quality on 26.7 percent of the hatchery supply flocks. Use of superior sires on hatchery supply flocks will increase hen housed average production for the country as a whole from the current production of about 112 toward the 176 achieved by the U.S.R.O.P. breeders.

Pullorum testing was required for all breeding birds under the plan during the past fiscal year. The number of birds tested increased to more than 20 million which may be compared to less than 4.5 millions during the first year of the plan. Percentage of infection among breeding birds tested has decreased from about 3.7 during the first year of the plan to about 2.4 during the past fiscal year. Surveys in several States indicate that chick brooding losses have decreased proportionately as percentage of infection in breeding flocks has been reduced. The plan was extended to include turkeys for the first time during the fiscal year just ended. Breeders and hatcheries in 10 States cooperated in the turkey program.

Certification of pedigrees of imported registered livestock: During the fiscal year 1944, a total of 24,339 purebred animals were certified, an increase of 1,909 animals over the previous year. Certifications of animals by species were: 88 horses; 20,697 cattle; 2,736 sheep; 13 goats; 350 swine; and 455 dogs. The Anglo-Nubian Section of the British Goat Society Herd Book was recognized in 1943.

(d) Diseases of Animals

Appropriation Act, 1945	\$756,939
Proposed transfer in 1946 estimates from "Salaries and expenses, animal industry, Agricultural Research Administration,"	
general administrative expenses	+24,179
Total available, 1945	781,118
Budget estimate, 1946	708,900
Change for 1946:	
Overtime decrease -72,142	
Other decrease -76	-72,218

PROJECT STATEMENT

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
1. Investigations of brucel- losis (contagious abortion): of livestock	235,511	248,111	248,035	-76 (1)
2. Investigations of infec- tious diseases of livestock: and poultry caused by bac- teria and fungi, other than: brucellosis	84,923	113,537	113,537	- -
3. Investigations of infec- tious diseases of livestock: and poultry caused by viruses	82,128	80,379	80,379	- -
4. Investigations of non- infectious diseases of livestock and poultry	40,486	43,340	43,340	- -
5. Investigations of protozoan parasites of livestock and poultry, including cocci- diosis	67,727	64,971	64,971	- -
6. Investigations of worm parasites of livestock and poultry, such as tapeworms, flukes, and roundworms ...	61,258	70,411	70,411	- -
7. Investigations of miscel- laneous parasites of live- stock and poultry	36,360	39,412	39,412	- -
8. Investigations of treat- ments for parasites of live- stock and poultry	43,055	48,815	48,815	- -
9. Overtime costs	69,425	72,142	- -	-72,142
Unobligated balance	38,065	- -	- -	- -
Total available	758,938	781,118	708,900	-72,218
Transferred to "Salaries and expenses, Office of Informa- tion, Department of Agri- culture"	+200	- -	- -	
Total estimate or appropriation (1944 and 1945 adjusted for comparability)	759,138	781,118	708,900	

INCREASES OR DECREASES

The decrease in this item for 1946 consists of the \$72,142 decrease for overtime, and

(1) A decrease of \$76 under the project "Investigations of brucellosis (contagious abortion) of livestock" due to a rounding off of the appropriation total.

CHANGES IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored; deleted matter enclosed with brackets):

Diseases of animals: For scientific investigations of diseases of animals, [including the alteration and construction of necessary buildings at Beltsville, Maryland (not to exceed \$5,000 for the erection or alteration of any one building),] and necessary expenses for investigations of tuberculin, serums, antitoxins, and analogous products, [\$756,939: Provided, That fees shall be charged for all diagnoses in connection with rabies, except those performed for agencies of the United States Government, in such amounts as the Secretary shall prescribe, and such fees shall be covered into the Treasury as miscellaneous receipts] \$708,900.

The first change deletes the language with regard to repairs and additions to and erection of buildings since a general limitation upon such expenditures is being proposed for the Agricultural Research Administration under the Office of the Administrator.

The second change deletes the words "Provided, That fees shall be charged for all diagnoses in connection with rabies, * * * fees shall be covered into the Treasury as miscellaneous receipts" inasmuch as authority for this service is now contained in Sec. 101 (e) of the Department of Agriculture Organic Act of 1944, Public Law 425, approved September 21, 1944.

WORK UNDER THIS APPROPRIATION

Objective: To obtain information leading to measures for the control of the infectious and non-infectious diseases of domestic animals, including poultry, which are of particular importance at the present time; and to develop practical methods of coping with the numerous parasites that produce stunting, unthriftiness, and deaths in livestock and poultry.

The Problem and its Significance: The losses to the livestock industry from diseases and parasites total millions of dollars annually. Many animal diseases and parasites are also communicable to man and are a menace to public health. Since the organization of the Bureau of Animal Industry, research work on the cause, mode of transmission, and

measures for the control of infectious and parasitic diseases, has been one of its major efforts.

To control diseases and parasites it is necessary to have certain fundamental information on the causative agents, how they are propagated, and how disease is produced and spread from one animal to another. When adequate information on these points is available, efforts can then be directed to the development of measures whereby losses from a particular disease can be reduced, or the disease even eradicated. These efforts may take in studies on sanitary measures, vaccination procedures, and the use of therapeutic agents. As a result of such research, great strides have been made in the control of many animal diseases and parasites in the United States through concerted efforts of Federal and State agencies. However, many problems are continually arising in disease control programs which need further investigation. Advances are constantly being made in methods of research, and new drugs are being developed for the treatment of diseases. Continued research on animal disease problems is essential to improvement of existing methods for their control and eradication. Moreover, new diseases are reported from time to time, and investigations are necessary to identify them and to develop methods for their control. Heavy losses are produced through poisoning of stock by plants, and considerable losses are caused also by non-infectious diseases. Full information is not at hand on many of the diseases affecting the nation's livestock and poultry. Work under this appropriation is directed toward obtaining information through research activities, both in the laboratory and in the field, on methods of controlling and eradicating diseases and parasites, and thereby safeguarding human as well as animal health.

General Plan: Investigations are made into methods of diagnosis, cause, mode of transmission, and methods of prevention, treatment, and control of the more important infectious and non-infectious diseases of livestock including poultry. These investigations embrace field and laboratory activities. Studies of the diseases as they exist in the field are made, and the bacteriological, serological, pathological, immunological, and animal inoculation studies are conducted in the laboratory.

To develop a practical and scientific basis for eradicating or controlling parasites, (1) studies are conducted on the distribution of these pests in the major agricultural regions of the United States, taking into consideration climate, soil types, pastures, and topography; (2) methods are developed for accurate diagnoses; (3) the infective stages are investigated with a view to developing methods for their destruction; (4) the mode of transmission is determined by experiments in the laboratory and observations in the field; (5) the injuries produced and symptoms exhibited by experimentally-infected animals are noted in order to develop sound methods for field diagnosis; (6) the immunological responses, if any, are investigated as aids in control; (7) weak links at which the vicious cycles of parasites may be broken are explored; (8) intermediate hosts are investigated and methods are devised for their eradication and control;

(9) field tests to develop promising control measures are conducted on a small scale under conditions that enable the investigators to determine the factors that might be involved; and, finally, (10) the most promising control measures are tested in the field in cooperation with farmers and stockmen, and control measures are adapted to meet varying conditions existing in different parts of the country.

To meet the ever-pressing need for affording infected animals prompt relief from the drain of parasitic infestations and saving the lives of young animals that have but little resistance to cope with mass attacks by parasites, experiments are conducted with drugs and chemicals to determine effective and inexpensive methods of destroying external parasites on, and removing internal parasites from, livestock and poultry. Investigations are conducted also to develop practical methods of destroying the infective stages of parasites in the manure, which is the most fertile source of parasitic infestation on the farm and range.

Examples of Progress and Current Program: The following examples of recent accomplishments and aspects of the broader problems involved are cited by projects.

Investigations of brucellosis (contagious abortion) of livestock: One of the important lines of work under this project consists of laboratory controlled studies of calfhooed vaccination practiced under natural conditions associated with severe herd infection. The close supervision and control permitted in this vaccination experiment continues to provide ample opportunity for detailed study of those problems connected with field vaccination which cannot be handled in a private herd. Animals are being vaccinated whenever they are available so that eventual numbers employed will be adequate for justifiable conclusions. At the present time four animals vaccinated as calves with strain 19 have terminated their first pregnancies. One of these failed to withstand exposure to infection and aborted a 236-day fetus. The other three produced normal full term calves with no evidence of established infection. Only two of the calves vaccinated with strain 45/20 (McEwen) have gone through their first pregnancies so far. Both of these, however, were found to be infected with virulent *Brucella abortus* at the termination of pregnancies.

The preliminary tests designed to compare the immunological value of strain 45/20 (McEwen) and strain 19 are incomplete and no attempt can be made, therefore, to evaluate the strain until final results are available. However, it appears that the McEwen strain has the distinct advantage of not producing vaccinal agglutinins of a type that will conform with present diagnostic tests and therefore additional study is planned to determine its value from an immunological standpoint.

Bacteriological studies dealing with the channels through which *Brucella suis* may be eliminated by infected swine have been in progress during the past year and results emphasize the importance of certain methods of transmission. This work, carried out in conjunction with artificial and natural exposures, has shown that infection may be

disseminated in a variety of ways. In order of their importance, these may be listed as follows: Uterine discharges at the time of abortion or farrowing, udder secretions, semen, urine, and probably intestinal excretions, although the latter has not been conclusively demonstrated. The uterine discharges and udder secretions are frequently infected even though clinical evidence of the disease in the form of abortions, may not be evident. Thus, the insidious manner in which infection may be spread probably explains, in part at least, some of the difficulties encountered in controlling the disease. The infected boar is also a potent factor in perpetuating the disease and certainly justifies serious consideration in any control program undertaken.

In an effort to develop measures for the control of swine brucellosis, immunological studies have been undertaken to determine the value of the use of vaccines prepared from a suis strain (responsible for causing brucellosis in swine) of reduced virulence. In comparative vaccination experiments with swine, pronounced differences were noted in the resistance to infection established by brucella abortus strain 19 (developed from the organism causing brucellosis in cattle) and suis King 8 strain (developed from a strain of the organism causing the disease in swine). The higher immunological value of the suis strain in stimulating resistance against virulent brucella suis infection indicates the place this vaccine may have in the control of the disease in swine. Repeated virulence determinations conducted in guinea pigs have demonstrated a stability of reduced virulence in the King 8 strain which is comparable with that associated with strain 19. Therefore, in the event further investigations establish its value as a satisfactory immunizing agent, there is considerable prospect that this strain will be acceptable also from the standpoint of stability.

Dissociative studies are being continued in all phases of the investigations conducted on swine brucellosis. The accumulated data from these studies should be helpful in providing a sound basis for correlating various dissociative phases with certain clinical manifestations in which they are frequently encountered. This phenomenon is also being followed closely as a direct comparison of similar variations characterizing the abortus group. There are encouraging indications that continued study may eventually provide sufficient information on the subject of bacterial variability to explain some of the obscure manifestations of this as well as other diseases.

Investigations of infectious diseases of livestock and poultry caused by bacteria and fungi, other than brucellosis: Bovine tuberculosis is being rapidly reduced. However, a considerable number of animals react to the test and show no evidence of tuberculosis infection. Improved methods of differentiating, before slaughter, between a reactor that is tuberculous and one that is not diseased are needed. Two methods of approach are being studied. One involves attempts to modify by chemical or other means the active principle of tuberculin in such a way that its non-specific property will be reduced or destroyed, while its specific properties are retained. The other method involves

comparative tests of products prepared from different types of organisms that are known to be capable of sensitizing animals to tuberculin. Both methods involve chemical and biological studies of acid-fast organisms and their products, and investigations along both lines were carried out during the past year.

In the continuation of the work on staphylococcal mastitis it was found that in a herd of 26 cows which had been treated with staphylococcal toxoid, 18 of which were shedding staphylococci in the milk from one or more quarters at the time of treatment, the staphylococcal antitoxin of the blood rose from a pre-treatment average of 4 units per cc. to an average of 25.4 units per cc. 7 days following treatment. However, the antitoxin content of the blood had dropped to an average of 7.3 units per cc. within 6 months following treatment. Although the percentage of cows infected with staphylococci has not been reduced by the treatment, the incidence of acute mastitis has materially decreased since treatment began.

Results of vaccinations for controlling swine erysipelas carried out in a number of States in the Corn Belt were quite satisfactory since less than 0.2 percent of the vaccinated animals developed erysipelas. In northeastern Nebraska, where swine erysipelas is quite prevalent and where considerable vaccination has been done, the incidence of arthritis in swine (due to erysipelas) has decreased 33 percent since 1941. Since the disease varies from year to year, even in the same locality, a continuation of the project over a sufficient length of time to take in seasonal variations is desirable.

Studies on the differentiation of Bacillus anthracis from anthrax-like organisms were continued. Fresh strains of Bacillus anthracis, isolated from spontaneously occurring field cases in cattle, sheep, and hogs, and strains isolated from man and spinose ear ticks, were studied and compared with anthrax organisms encountered in tissue specimens and soil specimens submitted to the laboratory for examination. Further studies on pathogenicity indicated that anthrax spores were highly resistant to freezing and desiccation. Frozen cultures were virulent after 10 years and spores in dried blood on cotton swab specimens were fully virulent after 6 years at room temperature. Stock culture strains, carried on plain agar for more than 11 years, also retained their virulency.

Investigations of infectious diseases of livestock and poultry caused by viruses: In 1943 equine infectious encephalomyelitis, which has been present annually in the United States in an epizootic form since 1931, reached its low ebb; only 4,768 cases with 1,622 deaths were reported from 34 States. As in former years, the disease reappeared in 1944 beginning in April. Eastern type virus was recovered from two centers in Maryland where that type has prevailed for more than a decade. Histopathological diagnoses were made in a number of instances. Rabies virus was recovered from a clinically diagnosed case of equine encephalomyelitis from an epizootic area in Arizona. Immunologically typed strains of encephalomyelitis virus are being maintained, and a

number of these have been supplied to qualified agencies in the United States and abroad.

Hog cholera continues to be the most important disease of hogs. In investigations during the past year there have been some indications that the potency of a vaccine for protecting hogs against the disease is related to the strain of virus from which it is derived. A virus received from Canada was used in exposure tests of several lots of pigs that had been treated with different Bureau vaccines. None of the pigs were protected. A vaccine was therefore prepared from the blood of the pigs injected with Canadian virus. This vaccine was used to treat a lot of pigs, other members of which were treated with the Bureau vaccine. Part of the pigs treated with each vaccine were exposed to the Canadian virus and the remainder to the Bureau virus. The Canadian vaccine protected against the Canadian as well as against the Bureau virus. The Bureau vaccine protected against the Bureau virus but not against the Canadian virus. The possibility of an immunological difference in virus was thus suggested, and is being investigated further. Hogs treated at Ames, Iowa, with a Bureau vaccine and then exposed in different groups to seven different domestic viruses were found to be adequately protected, thus indicating that the vaccine was capable of protecting against a number of different strains of domestic virus. During the year sufficient vaccine to treat about 10,000 hogs was prepared, and distributed by the Bureau. The use of this product in the field was attended with good results but it is still in the experimental stage.

Equine infectious anemia (swamp fever) is an infectious blood disease of horses and mules. The blood of a symptomless carrier horse, originally infected in April 1935, was shown by horse inoculation tests (the only means now available for absolute diagnosis) still to be infective in December 1943, a period of 8 years and 8 months. This illustrates the long period that the causative agent may exist in the blood of apparently recovered cases. Such an infected animal is a potential spreader of the disease. A cheaper, simpler, and more practical method than the horse inoculation test to detect these infected animals is needed to control and eradicate the disease and is an important objective of this project.

Brains from 18 dogs, 1 cow, and 1 fox, suspected of rabies, were examined by various diagnostic methods in a continuation of efforts to determine the relative efficiency of these methods, namely, microscopic examination of touch preparations, histologic examination, and the mouse inoculation test. A diagnosis of rabies was made in 12 dogs and 1 cow. In 9 dogs and the cow, all three diagnostic methods yielded positive findings. In the other 3 dogs, microscopic examination of touch preparations yielded negative finds, but histologic examination revealed pathological alterations, indicating a tentative diagnosis of rabies, which was confirmed in each case by the mouse inoculation test. These findings support the conclusion drawn last year that histopathological examination is a somewhat more efficient method for diagnosing rabies than the touch preparation method.

In 1943 for the first time, vesicular stomatitis appeared as a spontaneous disease in swine in the United States. In August a severe outbreak, confined to swine, occurred at a licensed Midwestern biological establishment. After a quarantine of the premises, involving all products of swine origin, had been established, a definite diagnosis of vesicular stomatitis, due to a virus having the immunological characteristics of the New Jersey type, was achieved. All products involved were tested and determined to be free of vesicular stomatitis virus before they were released for sale. All swine on the premises were disposed of, either by outright destruction or slaughter, and the premises were completely cleaned and disinfected. A gradual restocking of the premises and resumption of production was then permitted, and finally all restrictions were withdrawn. There has been no recurrence to date.

Investigations of noninfectious diseases of livestock and poultry:

Investigations of the plant, Eupatorium wrightii, which causes extensive cattle losses in southern New Mexico, provided information which enabled cattlemen to avoid most of this loss. Information on the toxicity of certain plants was obtained through field and laboratory investigations, and methods of prevention, and in some cases of treatment of poisoned animals, were studied.

In order to study the occurrence of vitamin A deficiency among fattening cattle in the Corn Belt area, steer calves have been fed a ration in which straw served as the roughage and yellow corn as the grain concentrate and at the same time the chief source of carotene. Even when consuming 11 to 14 pounds of yellow corn daily, the animals developed characteristic symptoms of vitamin A deficiency such as blindness, convulsions, stiffness, edema, and rapid breathing in hot weather, terminating in death. This test shows the importance of supplying well-cured high-quality hay and good-quality silage (both adequate sources of vitamin A) because yellow corn cannot be depended upon even when fed at a high level.

There is increasing interest in the nutritional aspects of necrotic enteritis in swine. This disease affects the young pigs particularly and has become associated with swine pellagra, which is of nutritional origin. Fundamentally, however, necrotic enteritis involves a bacterial infection. Studies thus far have been directed at the relationship of niacin to control of the disease in the presence of the infecting bacterial organism. There is considerable promise that treatment of affected pigs with niacin and perhaps other vitamins will aid in alleviating the effects of the disease.

Stilbestrol, a synthetic estrogenic hormone, was used effectively in several cases of retained placenta in cattle following parturition or abortions. In retained placenta, especially following abortions, it may not induce the expulsion of the fetal membranes, but it has proved effective in loosening cotyledons, which aids greatly in its manual expulsion. It is most effective in causing involution of the uterus

after the fetal membranes have been removed and in treating cases of metritis (an inflammation of the uterus). Stilbestrol proved to be very effective, also, in inducing abortion in pregnant ewes.

Investigations of protozoan parasites of livestock and poultry, including coccidiosis: During the past year it was estimated that an outbreak of anaplasmosis in Kansas occasioned a loss exceeding two million dollars. Many affected animals eventually recover from the disease, but the infective agent remains in their blood and they thus act as reservoirs for further spread of the disease. It is not possible so far to identify these carrier animals. Experiments have shown that the disease can be transmitted by flies, ticks, mosquitoes, and also through surgical instruments (dehorning saws, etc.) used on these carrier animals. All chemotherapeutic agents thus far tried have failed to eliminate the carrier state. Attempts to diagnose the carrier animal through serological means have so far resulted negatively. Continued efforts to develop a test to detect carrier animals and to find a chemotherapeutic agent which will eliminate the carrier state are being carried on.

Experiments are under way for the treatment of bulls affected with bovine genital trichomoniasis with iodine compounds designed to destroy the causative organisms, Trichomonas foetus, and restore the bulls to usefulness as herd sires. In some instances bulls were cured of the infections, but in others the treatment failed. This work is being continued in the hope of developing an effective treatment for the destruction of the organisms in bulls.

An analysis of data on the addition of ordinary commercial sulphur to the ration of sheep in feedlots, for the control of coccidiosis, showed that 600 lambs receiving from 0.5 to 1.5 percent sulphur in the ration continuously for 72 days were effectively protected from clinical coccidiosis. No visible ill effects were produced by the continuous feeding of sulphur in the amounts stated, and the lambs so fed showed a remarkably low death rate from all causes and compared favorably with untreated control animals in the rate of fattening. Although additional work must be done to develop this control measure on a practical basis, the evidence so far obtained shows the procedure to be practical, especially in view of the availability and low cost of this chemical.

Further experiments were conducted with W20 chicks to test the value of sulfaquinoxaline for the control of cecal coccidiosis, the most virulent form of this disease in poultry. Medication proved to be of no practical value when instituted later than the third day following exposure to infection. However, when instituted before exposure, and continued for the first 5 days after exposure, 0.5 percent concentration of the drug in the mash reduced the mortality from this disease appreciably. The conclusion reached as a result of the test is that for best results medication must be instituted at about the same time that the birds are exposed to infection or within the next day or so. Preliminary tests were made also with fowon compounds, and these yielded rather promising results.

Because the Department receives numerous inquiries concerning the value of vinegar for combating coccidiosis in poultry, tests were conducted to determine whether vinegar or acetic acid are of value for that purpose. A 0.05 percent solution of vinegar and a much stronger solution of acetic acid had no influence on the course of coccidiosis in chickens. Actually, the treated birds gained less weight than untreated infected birds.

Investigations of worm parasites of livestock and poultry, such as tapeworms, flukes, and roundworms: Investigations were conducted to determine whether horses can be protected from blood worms and related roundworms through the free-choice administration of phenothiazine with salt. After testing various salt and phenothiazine mixtures, some of which were only partially successful, it was determined that a mixture containing from 40 to 49 parts of salt and 1 part of phenothiazine was best adapted to this purpose. Maintenance on phenothiazine and salt had no deleterious effects of any kind and it was noted, moreover, that all horses tested, including those that did not respond favorably to the medication, so far as evidence of parasites was concerned, developed better coats and manifested a better physical condition than untreated ones. Free-choice medication appears to offer considerable promise, but many aspects of the problem are yet unexplored and unexplained.

Tests were made on combining phenothiazine with carbon disulphide in order to cut down the number of treatments necessary to keep horses free of various parasites. The tests indicated that the two drugs are compatible and effective in combination, and that a single treatment so administered is effective for the removal of bots and blood worms.

Studies were conducted to determine the effects of the hookworm infestation on sheep. It was found that the parasites make but little headway when they are swallowed by sheep, but that severe infections and skin lesions result when the larvae penetrate the skin. Twenty-five days after infection blood was detected in the droppings of the animals, and loss of blood continued as long as the animals remained infected. Coincident with the loss of blood, the hemoglobin and the red blood cells were reduced, and reached the lowest level about 11 to 14 weeks following experimental infection. In general, the results of the experiment showed that hookworm infection in sheep, uncomplicated by the presence of other parasites, produced anemia and retardation of growth, the extent of the injury produced depending upon the degree of infection. Loss of blood and weight occurred long before microscopic evidence of infection could be detected in the droppings.

Tests were made of the effectiveness of frequent administration of skim milk for the control of intestinal roundworms of pigs, kept under conditions where they were more or less constantly exposed to worm parasites. The results showed that skim milk is of value for the control of ascarids, nodular worms, and whipworms, and that it produces, moreover, satisfactory weight gains even when the pigs are kept under conditions that favor parasitic infection.

Investigations conducted in the Coastal Plain area of the South showed that when pigs were farrowed and kept subsequently under conditions designed to keep down to a minimum the acquisition of parasites during the suckling period, the animals required approximately 24 pounds less feed to produce 100 pounds of weight, than did comparable pigs kept under conditions where little attention was paid to parasite control. The principal control measures applicable to the Coastal Plain area of the South are treatment of sows shortly before farrowing to remove nodular worms, keeping the suckling pigs and sows on clean pastures, and finishing the pigs on temporary pastures.

Over 4,000 cattle of all types, including animals in the last stages of liver fluke disease, were treated experimentally under cooperative agreements with ranchers in Texas, with a hexachlorethane-bentonite suspension developed in the Bureau during the past year. Animals treated in the early stages of liver fluke disease showed no harmful effects following treatment; weak animals went off feed and showed grogginess for a few days; animals in advanced stages of liverfluke disease became debilitated and died. The treatment, as determined by post-mortem examinations, was nearly 99 percent effective for the removal of adult flukes from the bile ducts of the liver; for the removal of flukes of all sizes the efficacy was slightly over 93 percent. It was determined, moreover, that cattle in poor condition because of liver fluke disease showed remarkable improvement following treatment, and those with impaired breeding capacity recovered and bore normal calves.

Since phenothiazine is being recommended widely by commercial firms for the control of blackhead in chickens and turkeys, experiments were conducted to determine whether this method of control is effective. The administration for 3 to 4 weeks of phenothiazine to chickens and turkeys, in a concentration of 1 to 2 percent in the mash, failed to prevent infections with cecal worms, and most of the turkeys died of blackhead disease. Autopsies on the birds showed half-grown or younger cecal worms. Since a period of only 2 weeks is required for the cecal worm to reach maturity, it appears that phenothiazine exerts a selective action by removing the mature worms and leaving the young ones.

Investigations of miscellaneous parasites of livestock and poultry:

Investigations were made to determine the effects of commercial pork dehydrating processes on trichinae, with results that showed that these parasites were destroyed when the moisture content of the meat was reduced to from 5 to 10 percent of the original moisture. The rapidity of destruction of the parasites depended upon the temperature at which the dehydration process was carried out, the rapidity of drying, the drying temperature, as well as length of time that the meat was frozen prior to grinding.

In investigations of sarcocysts--minute parasites that occur in the muscles--it was determined that the presence of these parasites in pork produces a mushy condition when the meat is cured. Hams that

are even lightly infected lack resiliency after curing, and the flesh exhibits a tendency to fall apart upon being cut. It was determined, through continued investigations, that pigs acquire the organisms in the muscles as a result of eating feed that has become contaminated with the droppings of pigs or of other animals that harbor the intestinal stages of these parasites. Rats, dogs, chickens, and pigs harbor the intestinal stage after eating infected flesh. Presumably these animals serve to propagate the infection.

The Index Catalogue of Medical and Veterinary Zoology, which is a storehouse of information on parasites of man and domestic animals in different parts of the world, was made available to the Army and Navy for use in connection with mapping the distribution of various tropical diseases in the theatres of war where our armed forces now operate. The catalogue was made available also to representatives of National Research Council and of the National Institute of Health in connection with studies on malaria and other parasitic diseases. Considerable information was compiled in connection with various parasitic diseases of animals in various parts of the world that might be introduced into this country through dogs and other pets by returning soldiers. This information will afford a basis for taking necessary precautionary measures against the introduction into the United States of exotic animal diseases from which this country is now free.

Investigations of treatments for parasites of livestock and poultry:

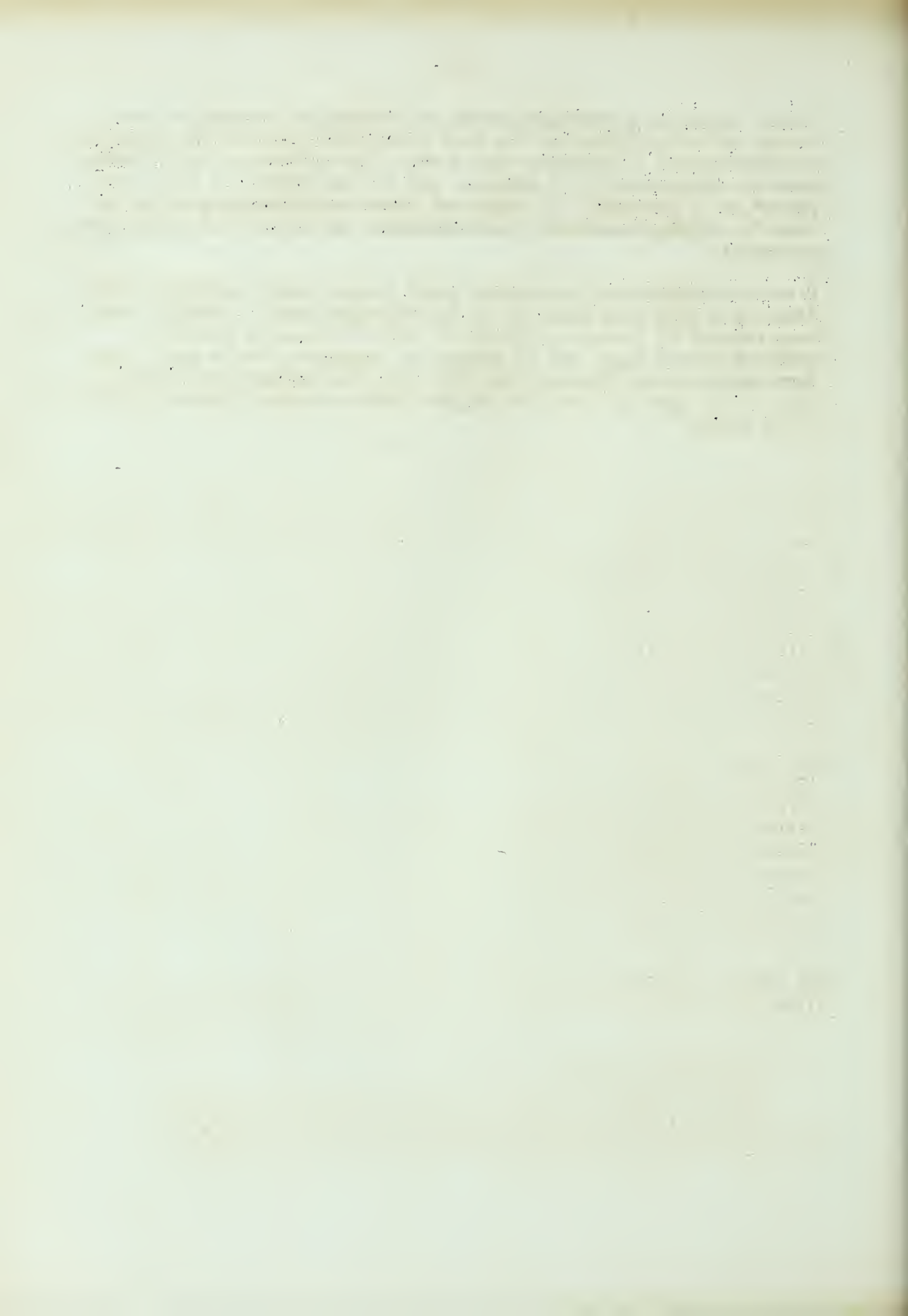
A comparison was made of the standard wash, a dip, and dusting powders--all containing rotenone--to determine their relative efficacies for the destruction of cattle grubs. The efficacies of the wash and dip ranged from 85 to nearly 100 percent, with an average efficacy of well over 90 percent; rotenone-containing dusts yielded erratic and inconsistent results, the efficacies ranging from 21 to 92 percent with an average efficacy of about 60 percent. Dusts proved relatively ineffective against young grubs and much more effective against fully-grown ones.

Experiments were conducted with a dip containing nicotine fixed on an inert carrier--bentonite--to determine its value for the destruction of sheep ticks. A single dipping in this dip did not eradicate ticks, but it did temporarily reduce the extent of infestation on the dipped sheep. The product was found to be nontoxic and quite safe for use. Dips containing small quantities of derris powder or cube powder not only killed all ticks present following a single dipping, but the dip materials that were retained in the fleece proved lethal to newly emerged ticks for a continuous period of at least 7 weeks.

Experiments were conducted to develop a safe and practical treatment for the eradication of foot lice of sheep. It was determined that passing sheep through a wading tank containing rotenone destroyed the foot lice but had no effect on the eggs of these parasites. In preliminary experiments a 1 percent suspension of DDT (dichloro-diphenyl-trichloroethane) and 10 percent emulsified crude oils yielded encouraging results.

Sodium flouride, a substance which is ordinarily regarded as toxic, showed definite promise as the most effective treatment yet discovered for the removal of ascarids from swine. The efficacy of this treatment was approximately 95 percent, and in the therapeutic doses used, it proved to be nontoxic. In sheep and goats anthelmintic promise was shown by diphenylene oxide, lead arsenate, and several other chemical compounds.

A canine anthelmintic 4-tertiary butyl phenol showed excellent action. Given at a dose rate from 0.1 to 1.0 gram per pound of weight, the drug removed 97 percent of hookworms from 10 dogs, 97 percent of ascarids from 5 dogs, and 74 percent of whipworms from 8 dogs. The best results were obtained when this drug was administered at the rate of 0.2 gram per pound of weight, after a fasting period of 18 to 24 hours.



(e) Eradicating Tuberculosis and Bang's Disease

Appropriation Act, 1945 (including \$343,959 reappropriation) ...	\$5,777,191
Proposed transfer in 1946 estimates from "Salaries and expenses, animal industry, Agricultural Research Administration," general administrative expenses	+55,000
Total available, 1945	\$5,832,191
Budget estimate, 1946:	
Direct appropriation ...	5,048,000
Reappropriation	800,000
Change for 1946:	
Overtime decrease	-439,640
Increase	+455,449
	<u>+15,809</u>

PROJECT STATEMENT

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
1. Eradicating tuberculosis in livestock (including poultry	1,259,421	1,330,025	1,394,755	+64,730 (1)
2. Eradicating Bang's disease in cattle	3,617,786	4,062,526	4,453,245	+390,719 (1)
3. Overtime costs	397,968	439,640	- -	-439,640
Unobligated balance	- -	- -	- -	- -
Total available	5,275,175	5,832,191	5,848,000	+15,809
Transferred to:				
"Salaries and expenses, Office of Information, Department of Agriculture" ..	+800	- -	- -	
"Salaries and expenses, animal industry, Agricultural Research Administration," meat inspection ...	+418,866	- -	- -	
1944 balance available in 1945	+343,959	-343,959	- -	
1943 balance available in 1946	- -	- -	-800,000	
Total estimate or appropriation (1944 and 1945 adjusted for comparability)	6,038,800	5,488,232	5,048,000	

INCREASES OR DECREASES

The net increase of \$15,809 in this item for 1946 consists of the \$439,640 decrease for overtime, and the following:

- (1) An increase of \$455,449 to cover additional operating expenses and indemnity payments incident to overdue retests of cattle.

Objective: To make retests of cattle for tuberculosis and brucellosis (Bang's disease) that are overdue and to take up work in a limited number of new herds which have been on the waiting list for a long time.

The Problem and Its Significance: The work of testing cattle for tuberculosis and brucellosis in the campaigns conducted in cooperation with State officials for the elimination of these diseases has had to be drastically curtailed in recent years. In general, farmers are required to stand the loss of one-third of the difference between the appraised value of a reacting animal and the amount received by him when the animal is sold for slaughter, the State pays one-third, and the Federal Government matches the State's payment. The farmer therefore expects that retests of his animals will be made at intervals which will keep his losses at a minimum. Usually herds are retested each 3 years to assure that the incidence of tuberculosis and brucellosis therein will be maintained at all times at a minimum. Experience has shown that approximately 3 years may safely be permitted between tests, but that when greater periods are allowed to elapse, reinfection may take place and the cost of removing infected animals increases out of all proportion to the cost of making retests at 3-year intervals. It therefore becomes imperative, if the campaigns for the eradication of tuberculosis and brucellosis in livestock are to be maintained at a high state of efficiency and the gains so far made are to be maintained, that additional veterinary personnel be assigned to the work as rapidly as possible.

Plan of Work: Additional veterinarians and nonprofessional persons will be employed to engage in this work, and will be assigned to the States where most needed. It is estimated that approximately one-half of the increase will be used for the payment of indemnities for reactors and one-half for operating expenses.

CHANGE IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

Eradicating tuberculosis and Bang's disease: For the control and eradication of the diseases of tuberculosis and paratuberculosis of animals, avian tuberculosis, and Bang's disease of cattle, [\$5,433,232] \$5,048,000, together with not to exceed [\$343,959] \$800,000 of the

unobligated balance of the appropriation for the fiscal year [1944] 1943: Provided, That [in carrying out the purpose of this appropriation, if in the opinion of the Secretary it shall be necessary to condemn and destroy tuberculous or paratuberculous cattle, or cattle reacting to the test for Bang's disease, and if such animals have been destroyed, condemned, or die after condemnation, he may, in his discretion, and in accordance with such rules and regulations as he may prescribe, expend in the city of Washington or elsewhere such sums as he shall determine to be necessary for the payment of indemnities to owners of such animals but, except as hereinafter provided,] no part of the money hereby appropriated shall be used in compensating owners of [such] cattle except in cooperation with and supplementary to payments to be made by State, Territory, county, or municipality where condemnation of [such] cattle shall take place, nor shall any payment be made hereunder as compensation for or on account of any such animal if at the time of inspection or test, or at the time of condemnation thereof, it shall belong to or be upon the premises of any person, firm, or corporation to which it has been sold, shipped, or delivered for the purpose of being slaughtered: * * * *

The first change proposes a reappropriation of \$800,000 of the unobligated balance of fiscal year 1943 funds.

The second, third, and fourth changes propose and relate to the deletion of language authorizing the condemnation and destruction of tuberculous or paratuberculous cattle and the payment of indemnities therefor, since provision for these items is contained in Sec. 101 (a) of the Department of Agriculture Organic Act of 1944, Public Law 425, approved September 21, 1944.

Resume of Financing and 1945 Allotment:

Tuberculosis eradication has been in progress since 1917. During the fiscal years 1935 to 1938, inclusive, regular and special funds (Jones-Connally and Section 37, Act of August 24, 1935) were used for this purpose. Bang's disease eradication was inaugurated in the fiscal year 1935, and this work was financed exclusively with special funds through the fiscal year 1938. Since 1939 the Agricultural Appropriation Act has provided for continuation of tuberculosis and Bang's disease eradication under one consolidated appropriation item entitled "Eradicating tuberculosis and Bang's disease."

Table 1, which follows, shows the direct appropriations, reappropriations of regular and special funds, and net availability under the consolidated item.

TABLE I

Statement of Direct Appropriations, Reappropriations of Regular and Special Funds, and Net Availability under "Eradicating Tuberculosis and Bang's Disease." Fiscal Years 1939-1945.

Fiscal year	Direct appropriation	Reappropriation	Total appropriation	Amount re-appropriated in subsequent years	Net availability
1939	\$5,403,000	\$7,827,000	1/ \$13,230,000	\$4,000,000	\$9,230,000
1940	8,300,000	4,000,000	1/ 12,300,000	5,450,000	6,850,000
1941	4,300,000	4,000,000	1/ 8,300,000	750,000	7,550,000
1942	5,598,140	750,000	2/ 6,348,140	-	6,348,140
1943	3,575,669	2,463,331	3/ 6,039,000	-	6,039,000
1944	5,983,800	-	5,983,800	-	5,983,800
1945	5,433,232	343,959	4/ 5,777,191	-	5,777,191
1946 est.	5,048,000	800,000	5/ 5,848,000	-	5,848,000

- 1/ Estimated unexpended balance of special funds (Jones-Connally and Section 37, Act of August 24, 1935).
- 2/ Unobligated balance of 1941 funds under this head.
- 3/ \$1,450,000 unobligated balance of 1940 funds under this head and \$1,013,331 unexpended balances of appropriations heretofore made for "Eradication of Foot-and-Mouth and Other Contagious Diseases of Animals."
- 4/ Unobligated balance of 1944 funds under this head.
- 5/ Unobligated balance of 1943 funds under this head.

Table II, which follows, shows by states and territories, the allotments of funds for tuberculosis and Bang's disease during the fiscal year 1945.

TABLE II

Eradicating Tuberculosis and Bang's Disease
1945 Allotments

State	Eradicating tuberculosis		Eradicating Bang's disease		Total
	Salaries and expenses	Indemnities	Salaries and expenses	Indemnities	
Alabama	\$ 23,000	\$ 500	\$ 75,000	\$ 50,000	\$148,500
Arizona	5,000	2,500	20,000	3,000	30,500
Arkansas	6,000	100	80,000	18,000	104,100
California	115,000	8,000	3,580	0	126,580
Colorado	10,240	2,500	24,230	0	36,970
Connecticut	19,000	13,000	10,000	25,000	67,000

TABLE III

Eradicating Tuberculosis and Bang's Disease - Continued

State	Eradicating tuberculosis		Eradicating Bang's disease		Total
	Salaries	Indemni-	Salaries	Indemni-	
	and expenses	ties	and expenses	ties	
Delaware	5,000	1,000	14,000	20,000	40,000
Dist. of Col.	53,051	0	145,740	0	198,791
Florida	20,000	500	55,000	25,000	100,500
Georgia	7,000	0	58,000	25,000	90,000
Idaho	8,000	500	37,000	21,000	66,500
Illinois	27,300	31,000	79,815	15,000	153,115
Indiana	42,185	5,200	25,920	0	73,305
Iowa	35,070	49,000	78,455	140,000	302,525
Kansas	15,140	4,000	47,450	1,500	68,090
Kentucky	15,690	2,500	32,225	14,000	64,415
Louisiana	11,000	1,000	45,000	30,000	87,000
Maine	16,000	500	55,000	75,000	146,500
Maryland	32,130	7,000	57,415	60,000	156,545
Massachusetts ...	22,000	17,000	0	0	39,000
Michigan	25,690	9,500	91,225	50,000	176,415
Minnesota	26,715	4,000	86,260	65,000	181,975
Mississippi	17,000	500	40,000	20,000	77,500
Missouri	22,230	500	70,750	40,000	133,480
Montana	22,000	500	10,000	30,000	62,500
Nebraska	18,780	1,500	27,180	10,000	57,460
Nevada	6,000	500	8,000	0	14,500
New Hampshire ...	9,000	3,500	35,000	120,000	167,500
New Jersey	18,265	20,000	12,615	15,000	65,880
New Mexico	1,000	500	35,000	6,000	42,500
New York	48,375	72,000	14,450	25,000	159,825
North Carolina ..	10,000	400	28,000	15,000	53,400
North Dakota	21,000	500	98,000	12,000	131,500
Ohio	23,600	5,500	79,860	183,000	291,960
Oklahoma	13,080	1,000	41,930	0	56,010
Oregon	16,000	5,000	70,000	40,000	131,000
Pennsylvania	16,290	51,000	102,290	435,000	604,580
Rhode Island	8,000	2,500	1,000	2,000	13,500
South Carolina ..	9,000	500	19,000	4,000	32,500
South Dakota	31,000	2,000	27,000	5,000	65,000
Tennessee	24,000	500	24,000	30,000	78,500
Texas	34,260	2,500	28,935	0	65,695
Utah	12,000	6,000	31,000	0	49,000
Vermont	8,000	6,000	16,000	1,000	31,000
Virginia	24,000	5,000	38,000	75,000	142,000
Washington	26,000	3,500	55,000	85,000	169,500
West Virginia ...	16,000	500	40,000	15,000	71,500
Wisconsin	42,460	20,000	100,815	305,000	468,275
Wyoming	10,000	300	16,000	1,000	27,300
Alaska	0	500	0	0	500
Hawaii	1,000	1,000	0	0	2,000
Puerto Rico	37,000	7,000	6,000	3,000	53,000
: \$1,085,551 : \$380,000 : \$2,197,140 : \$2,114,500 : \$5,777,191					

WORK UNDER THIS APPROPRIATION

Objective: The eradication of tuberculosis in livestock (including poultry), paratuberculosis in cattle, and Bang's disease (brucellosis or contagious abortion) in cattle, with partial compensation to owners of cattle condemned and destroyed because of being affected with the diseases.

The Problem and its Significance: Tuberculosis is one of the most serious diseases of cattle, swine, and poultry, because of its effect in reducing production and causing a considerable loss of meat condemned as unfit for food. It is also a menace to the public health, as it may be transmitted to children using unpasteurized milk and dairy products from infected cows, causing tuberculosis of the glands and bones. Much has been done in eliminating bone tuberculosis, which frequently manifests itself in humans as hunchback, by the eradication of tuberculosis in cattle. Notwithstanding the great progress made in stamping out this disease, it is reliably estimated that an annual loss of \$10,000,000 can be attributed to it, \$5,500,000 of which is borne by the poultry industry, \$2,000,000 by the swine industry, and \$2,500,000 by the cattle industry. In swine it may progress to a point where it becomes generalized, but in most of the carcasses showing evidence of the disease on post-mortem examination, only slight lesions are found. Avian (fowl) tuberculosis is particularly difficult to eradicate because of the fact that the organisms are so resistant and live for many months in the soil.

Bang's disease is found among cattle in practically all sections of the United States, although the degree of infection is much greater in some localities than in others. In those sections where there has been a considerable exchange of cattle, a high degree of infection is found. This condition also obtains in and around the large milk-shed areas. It is conservatively estimated that this disease is responsible for an annual loss of \$30,000,000 to our livestock industry. Approximately 75 percent of all breeding trouble in cattle is caused by this disease, the principal effects of which are (1) abortion or premature birth of calf; (2) reduction in the production of milk; (3) retention of fetal membranes, with very serious results; (4) sterility or failure to breed successfully, and (5) predisposition of newly-born calves to other serious diseases, especially such diseases as scours and pneumonia, and at times, mastitis.

In recent years it has been proved that undulant fever in man is caused by the same germ that causes Bang's disease in cattle. A considerable number of such cases have been reported which resulted from the ingestion of Bang's disease germs in raw milk. Handling pork products coming from animals infected with Bang's disease is also a means of transmitting undulant fever to man.

General Plan--Cooperation with States: Eradication work is conducted in cooperation with livestock sanitary officials of the various States, and is governed by state laws and regulations. Tuberculosis eradication is carried on under the test-and-slaughter plan, but cooperating States may elect one or more of the three plans for Bang's disease eradication: (a) test-and-slaughter plan, (b) test-and-slaughter with calfhood vaccination, and (c) test-and-retention of reactors, with calfhood vaccination.

Under the test-and slaughter plan, tests are applied to the cattle by veterinarians employed by the Bureau, states and counties, and by practicing accredited veterinarians, to detect the existence of any infection in the living animal. Reactors are appraised at their market value, taking into consideration their quality as breeding and dairy animals, after which they are slaughtered under supervision. In addition to their salvage value, the owner receives from the Federal Government one-third of the difference between the appraised value and the salvage, not to exceed \$25 for grade animals and \$50 for registered purebred animals. Federal payment is further limited to an amount not exceeding that paid by the cooperating state, county, and municipality. Payment from all sources, including the salvage, cannot exceed the appraised value of the animal.

Under the test-and-slaughter with calfhood vaccination plan, all cattle over 6 months are usually tested. The vaccination of animals is confined to calves between 4 and 8 months of age, 6 months being the preferable age. The age and date of vaccination of each animal is properly recorded, and the identity of each animal definitely established. Animals in herds in which vaccination is practiced are not to be disposed of, except for immediate slaughter, without written permission of the cooperating state or Bureau officials. A herd under the vaccinal plan may be certified as a "herd Free of Brucellosis" for a period of 1 year when all animals in the herd over 2 years of age reveal at least 2 negative reactions to official blood agglutination tests, properly spaced, and the vaccinated animals under 2 years of age show a satisfactory blood titer. The payment of Federal indemnity for adult cattle in such herds that react to the test depends upon the circumstances in the individual states.

Under the test-and-retention of reactors, with calfhood vaccination plan, the owners of herds practicing calfhood vaccination are permitted to hold reactor cattle under strict quarantine until they can be replaced by healthy animals. The milk from such animals is, of course, properly pasteurized. No Federal payment will be made for these reactors at any future date.

Supervision is maintained over the disposition of reactors which have been consigned to public stockyards for slaughter, and over the testing at such stockyards of cattle to be shipped interstate for dairy or breeding purposes.

In combating avian tuberculosis, the veterinarians employed in the field cooperate with the local livestock sanitary officials and the owners of poultry flocks. Cooperation is also obtained from certain local organizations and owners of hatcheries.

Examples of Progress and Current Programs:

Eradicating tuberculosis in livestock (including poultry): The cooperative campaign to eradicate this disease was inaugurated in 1917. At that time it was estimated that approximately 5 percent of all the cattle in the United States were affected. Since the beginning of the work it has been possible to reduce the infection of bovine tuberculosis throughout the country to less than two-tenths of 1 percent of the cattle

population. However, during the present war, the work of retesting herds at regular intervals has been drastically curtailed due to personnel shortages. In spite of this, the percentage of reactors disclosed during the fiscal year 1944 was only a fraction of 1 percent greater than during the previous year. Since the cooperative work was undertaken, through the fiscal year 1944, approximately 271,129,000 tuberculin tests have been applied to cattle, disclosing about 3,872,000 reactors.

During the fiscal year 1944 the average appraisal of reactors was \$154.53; the average salvage, \$59.93; the average state indemnity, \$36.07; and the average Federal indemnity, \$21.72. It will thus be noted that on an average appraisal of \$154.53, the owner received from all sources for his tuberculous animals a total of \$117.72. On June 30, 1944, 6,153,069 herds, containing 64,519,652 cattle were under supervision for the eradication of tuberculosis.

During the past year the field veterinarians engaged in tuberculosis eradication work observed approximately 62,012 flocks, containing about 9,872,89 fowls located in 9 states. About 15 veterinarians of the Bureau devoted practically their entire time to the avian tuberculosis project, visiting 11,313 farms, and observing 2,065,344 fowls. Infection was reported on 1,341 farms.

The work in connection with the eradication of paratuberculosis (Johne's disease) was continued. While this disease is not widespread, it does exist to a slight extent among the cattle in many States as it is quite difficult to control. During the past year 2,578 cattle were tested, of which 83, or 3.2 percent, reacted.

All the tuberculin used in this work is prepared by the Bureau. During the past fiscal year approximately 829,000 cc. of this product were used in the work.

Eradicating Bang's disease (brucellosis) in cattle: Efforts to control and eradicate Bang's disease were taken up in July 1934 by the Federal Government in cooperation with the State livestock sanitary officials and the cattle owners. When this work was begun, the incidence of the disease was very high in many localities, and the average for the entire country was estimated at 10 percent. This has been reduced to about 4.3 percent, but since the beginning of the present war it has been impossible to meet the demands for the work due to the lack of trained veterinarians and to other conditions caused by the war. Brucellosis may be communicated to humans through milk that is not properly pasteurized and therefore there is considerable demand for the work in those localities where pasteurization is not conducted. Most of the States have plans for accrediting individual herds as free from Bang's disease, and at the close of the fiscal year 1944 there were about 42,500 such herds containing approximately 860,000 cattle. Approximately 2,255,000 herds, containing about 17,325,000 cattle, were under official supervision for the eradication of the disease.

The plan inaugurated in December 1939 of establishing modified accredited Bang's disease-free areas, that is, areas in which cattle infection does not exceed 1 percent and herd infection not more than 5 percent, has proceeded quite favorably despite the shortage of trained veterinary personnel.

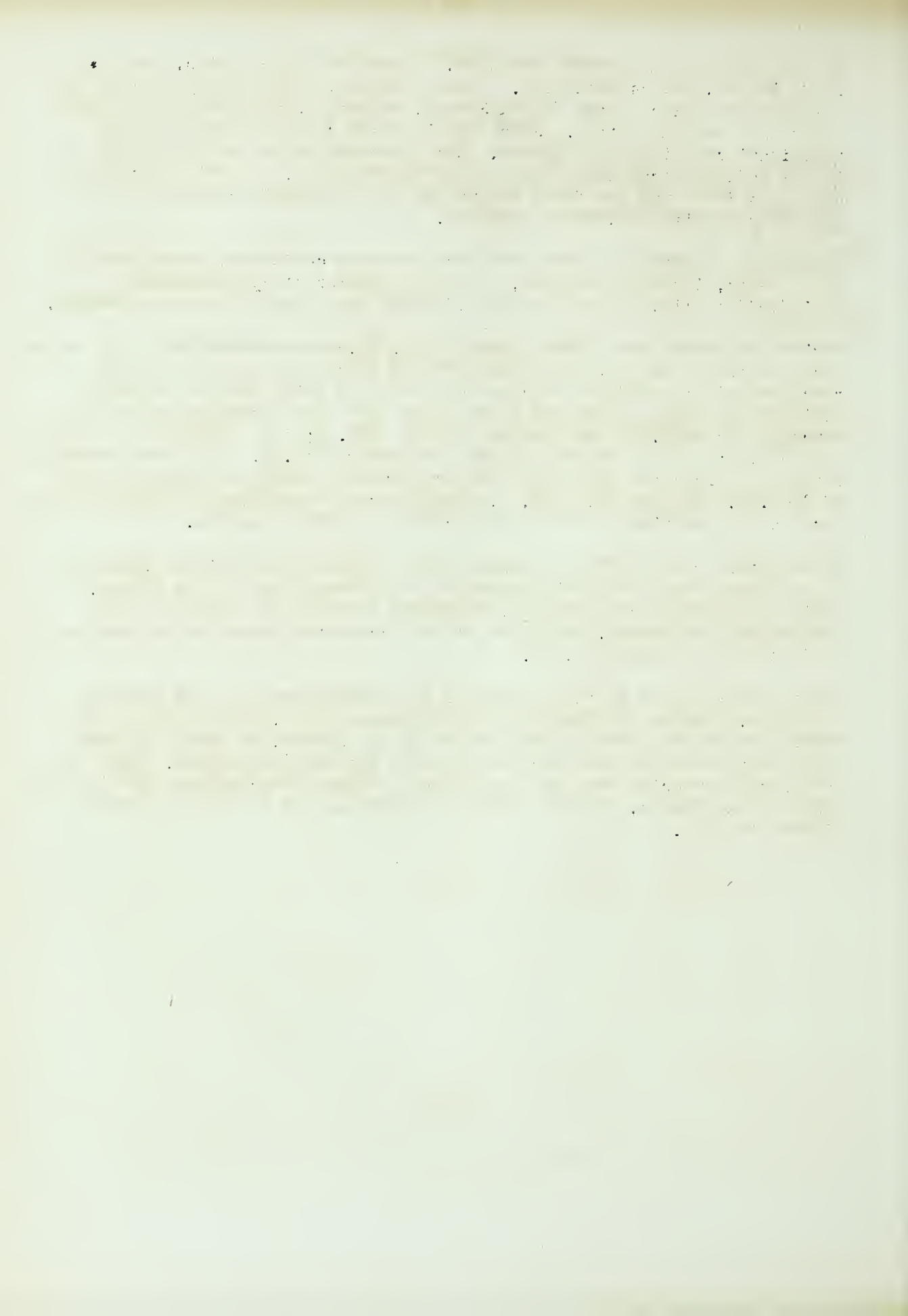
At the close of the fiscal year 1944, a total of 591 counties, located in 22 States, had so qualified. These counties, which are 19 percent of the total counties in the United States, contain approximately 5,565,000 dairy and breeding cattle. Area work is being conducted in about 150 additional counties in 24 States. All the counties in North Carolina are in the modified accredited Bang's disease-free area. It will be recalled that this State was the first to qualify as a modified accredited area in the tuberculosis eradication campaign.

During the 10 years in which this work has been conducted, agglutination blood tests, including retests, have been applied to approximately 65,158,000 cattle, of which about 2,766,000 have been classed as reactors.

During the fiscal year 1944, a total of 5,235,912 agglutination blood tests were applied to cattle, disclosing 226,079 reactors, including 75,499 reactors held in calfhood vaccination herds for which Federal indemnity will not be paid. During the fiscal year 1944 the average appraisal of reactors was \$143.34; the average salvage, \$59.75; the average state indemnity \$22.54; and the average Federal indemnity, \$19.30. The owner received from all sources for his Bang's disease reacting cattle an average total of \$101.59. On June 30, 1944, 2,254,235 herds, containing 17,326,138 cattle, were under supervision for the eradication of Bang's disease.

Satisfactory results have continued with calfhood vaccination. This work is conducted under official supervision in practically all the States. During the past fiscal year 392,232 calves between the ages of 4 and 8 months were vaccinated, the total number vaccinated since the project began in January 1941 being 770,877.

Careful supervision of the testing of all vaccine used in this work was continued. During the fiscal year 1944 samples of 2,714 batches of commercially prepared vaccine were tested by the Bureau, of which 191 were found unsatisfactory for vaccinal purposes and order destroyed. Some of the Brucella vaccine used in the official calfhood vaccination work is prepared by the Bureau, as well as all the antigen used in official Bang's disease testing.



(f) Hog-Cholera Control

Appropriation Act, 1945	\$115,440
Proposed consolidation in the 1946 estimates with "Salaries and expenses, animal industry, Agricultural Research Administration," inspection and quarantine	-115,440
Total available, 1945	- -
Budget estimate, 1946	<u>- -</u>

This subitem of appropriation is proposed for transfer to and consolidation with the subitem of appropriation "Inspection and quarantine".

(g) Inspection and Quarantine

Appropriation Act, 1945	\$1,003,130
Proposed transfer in 1946 estimates from:	
"Salaries and expenses, animal industry, Agricultural Research Administration," general administrative expenses.	+32,200
"Salaries and expenses, animal industry, Agricultural Research Administration," hog-cholera control	+115,440
Total available, 1945	1,150,770
Budget estimate, 1946	999,600
Change for 1946:	
Overtime decrease	-166,108
Increase	+14,938
	<u>-151,170</u>

PROJECT STATEMENT

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
<u>Bureau of Animal Industry:</u>				
1. Scabies eradication ...	\$96,417	\$105,373	\$105,373	- -
2. Control over interstate shipment of livestock for the purpose of preventing the spread of communica- ble diseases	310,920	321,652	321,652	- -
3. Determination by in- spectors in the field of the existence of disease	38,197	53,567	53,567	- -
4. Inspection and quaran- tine of import animals .	101,333	110,787	110,787	- -
5. Supervision over the importation of hides and other animal by-products, forage, etc.	57,397	62,646	62,646	- -
6. Inspection and testing of animals for export ..	2,845	2,636	17,574	+\$14,938 (1)
7. Eradicating cattle ticks	214,326	198,844	198,844	- -
8. Hog cholera control ...	101,460	103,162	103,162	- -
9. Portion of funds for enforcement of 28-hour law retained by Bureau of Animal Industry to cover cost of services per- formed for Office of Distribution on that project	- -	16,500	16,500	- -
10. Overtime costs	158,729	165,139	- -	-165,139
Unobligated balance	49,925	- -	- -	- -
Total available, Bureau of Animal Industry	1,131,549	1,140,306	990,105	-150,201

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
Office of Distribution:				
11. Enforcement of the 28-				
hour law	\$22,126:	\$9,495:	\$9,495:	- -
12. Overtime costs	3,869:	969:	- -:	-\$969
Unobligated balance	- -:	- -:	- -:	- -
Total available, Office				
of Distribution	25,995:	10,464:	9,495:	-969
Total estimate or appro-				
priation (1944 and				
1945 adjusted for				
comparability)	1,157,544:	1,150,770:	999,600:	-151,170

INCREASES OR DECREASES

The net decrease of \$151,170 in this item for 1946 consists of the \$166,108 decrease for overtime, and the following:

(1) An increase of \$14,938 under the project "Inspection and testing of animals for export" to handle increased livestock exports

The increase is requested to handle an anticipated larger volume of inspection and testing of animals to be exported. Such animals must be subjected to diagnostic tests in the districts of origin. The animals, furthermore, must be inspected at ports or embarkation. The installation of facilities and equipment on board the transporting vessels and the provision of feed and water for the voyage must be inspected for adequacy. Personnel now available is not sufficient to handle such work for the anticipated increase in volume of animals to be exported.

CHANGES IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

Inspection and quarantine: For inspection and quarantine work, including the [eradication of] control and eradication of hog cholera and related swine diseases, southern cattle ticks, scabies in sheep and cattle, and dourine in horses, [the inspection of southern cattle,] the supervision of the transportation of livestock, [and] the inspection of vessels, the execution of the twenty-eight-hour law, the inspection and quarantine of imported animals [, including the establishment and maintenance of quarantine stations and repairs, alterations, improvements, or additions to buildings thereon;] in accordance with the Act of August 30, 1890, (21 U.S.C. 102), and the inspection work relative to the existence of contagious diseases, [and the mallein testing of animals, \$1,003,130] \$999,600.

The first change deletes the words "eradication of" and inserts the words "control and eradication of hog cholera and related swine diseases," because of the proposed consolidation of the subappropriation "Hog-cholera control" with "Inspection and quarantine."

The second and third changes involve the deletion of the words "the inspection of southern cattle" and the word "and", which are unnecessary in this item.

The fourth change proposes the deletion of the words "including the establishment and maintenance of quarantine stations and repairs, alterations, improvements, or additions to buildings thereon;" and the insertion of the words "in accordance with the Act of August 30, 1890, (21 U.S.C. 102), and" in order to show definitely that the authority for such construction work stems from that Act.

The fifth change proposes the deletion of the words "and the mallein testing of animals" because specific authority in the appropriation language is not necessary; furthermore these tests are not being conducted at the present time.

WORK UNDER THIS APPROPRIATION

Objective: The control and eradication of hog cholera and related swine diseases, scabies in sheep and cattle, dourine in horses, and the cattle fever tick, in cooperation with the various States; the investigation of reported outbreaks of diseases among livestock to determine if they are communicable and, if so, assisting local authorities in their control and eradication; the application of tests in the field and in the laboratory for diagnostic purposes; the control over interstate movements of livestock as a means of preventing the dissemination of infections, which includes inspection at the principal market centers; the administration of the 28-hour law to prevent cruelty to animals in interstate transportation; the inspection and testing of livestock intended for export, to determine their freedom from disease, and the inspection of fittings and accommodations on vessels on which they are to be transported; the inspection and quarantine of livestock offered for importation; control over import animal byproducts, hay and straw, etc., to prevent the introduction or dissemination of communicable livestock diseases; and the administration, jointly with the Treasury Department, of Section 306 of the Tariff Act of 1930, prohibiting the importation of domestic ruminants or swine, or chilled or frozen fresh meats derived therefrom from countries where foot-and-mouth disease or rinderpest exists.

The Problem and its Significance: Scabies and the other diseases covered by this item are readily disseminated and their control or eradication is important for the protection of the livestock industry.

Shipment of livestock which are affected with a communicable disease may cause other animals to become infected and thus cause severe loss to livestock owners. The discovery at public stockyards of shipments of livestock affected with communicable diseases prevents the further spread of disease and permits the infection to be traced back to its source.

It is important to safeguard the livestock industry against serious losses by preventing the introduction of destructive communicable diseases from other countries through the importation of livestock or through the medium of infected or contaminated animal byproducts, hay, straw, etc. In order to protect and promote foreign trade it is necessary to prevent the exportation of any animals that have been exposed to any communicable disease and to provide for the safe transportation of those animals which may be exported.

General Plan--Cooperation with States: Disease control and eradication work is carried on in cooperation with the States involved. In public stockyards work an inspection force is maintained at principal market centers to prevent the dissemination of livestock diseases by detecting, segregating, and supervising the appropriate treatment or other disposal of animals affected with or exposed to contagious, infectious or communicable disease, and supervising the treatment and disinfection of all cars, trucks and other conveyances used in the transportation of infected animals, and all pens, chutes and alleys in which such animals are handled. In the import work under this item inspectors are assigned to stations along the international boundaries and on the seacoast to inspect animals, and when necessary to place them in quarantine, and to inspect animal byproducts, hay, straw, etc. In export work, animals are inspected and tested at ports and in the various districts of origin throughout the country.

Examples of Progress and Current Program:

Scabies eradication: During the fiscal year 1944 inspections and supervised dippings of sheep in the field totaled 8,951,460 and 660,484, respectively. Infection was found in 762 flocks, which was 33% less than for the previous year. All but a comparatively few of the infected flocks were located in Louisiana and in midwestern farm States. Cooperative eradication programs were inaugurated in Arkansas, Indiana, and Michigan. In all of the cooperating States, except Louisiana, where circumstances have made it necessary to defer systematic dipping, satisfactory progress has been made. In Illinois, where cooperative work was inaugurated last year, particularly promising results have been achieved. A few cases of reinfestation in western range areas, where the disease had been completely eradicated, were promptly dealt with.

Cattle scabies eradication work was continued with 1,281,454 inspections in the field and 100,582 dippings supervised. A few cases were found in previously infected areas in Kansas and Nebraska, showing the need for continual vigilance to guard against the spread of any undiscovered infection. The Bureau also assisted in handling a few cases of sarcoptic mange in several widely separated States.

Control over interstate shipment of livestock for the purpose of preventing the spread of communicable diseases: The work in connection with the inspection of livestock moving interstate does not vary greatly from year to year. It is most important that no animal affected by a communicable disease be permitted to pass through a public stockyard and establish a new center of infection. Thus, it is imperative that all animals in yards under Bureau supervision be thoroughly inspected.

The progressive increase in the transportation of livestock by motor truck rather than by railroad continued through the past fiscal year. In the fiscal year 1944 there were 46 cities where stations were maintained for public stockyard inspection. A total of 97,714,621 animals were inspected including 23,412,083 cattle, 29,150,427 sheep and 45,152,111 swine. A total of 728,781 animals were dipped or immunized including 1,707 cattle, 288,908 sheep, and 438,166 swine. Infectious cars received numbered 372 and cars cleaned and disinfected 3,296. These figures do not fairly indicate the amount of work involved for the reason that more work is required in the inspection of truck shipments than in the inspection of shipments received by rail.

Determination by inspectors in the field of the existence of disease: Under this project the work consisted mainly in continuing our efforts in cooperation with State authorities to determine the extent of dourine of horses in Arizona and southern California and in eradicating the disease where found. Work in the field consists of drawing blood samples from all horses in the areas involved and forwarding serum from each sample to Washington for the complement-fixation test in the Bureau's laboratory. All horses found by the test to be affected with dourine are destroyed. The infected area now appears to be confined to the State of Arizona in a region involving several Indian reservations where the work is carried on in cooperation with the Office of Indian Affairs. The factors that render the operations costly are that a majority of the horses in the infected areas are wild range animals difficult to gather and handle, especially under topographical and climatic conditions of the region. Of the nearly 19,000 horses tested, less than 1/3 of 1% were found to be affected with dourine and destroyed. The disease exists in the same general region in the Republic of Mexico and the Bureau continued its cooperation with Mexican authorities in testing over 500 horses, of which 78 were adjudged reactors and destroyed.

No serious outbreaks of anthrax or other communicable disease handled under this project occurred during the year. However, Bureau employees continued to administer preventive treatment to Indian-owned cattle on reservations where anthrax is known to exist. All reports of cases suspected of being foot-and-mouth disease were promptly and carefully investigated.

Inspection and quarantine of import animals: Inspections in the fiscal year 1944 at the various ports of entry totaled 336,281, or less than half the normal importations due to wartime restrictions. An embargo by the Canadian Government against the exportation of cattle except for dairy or breeding purposes was the greatest single factor in reducing the number of importations. During the year 7,312 head of livestock were refused entry on account of disease and a few were detained for further observation and testing for the purpose of determining their freedom from infection. The number and kind of animals inspected were as follows:

Ports of Entry	: Cattle	: Swine	: Sheep	: Goats	: Horses and Mules	: Asses	: Other Animals
Ocean ports.....	572	100	241	745	135	-	3
Canadian border ports	58,668	479	3,061	41	25,447	7	23
Mexican border ports	242,875	200	360	9	2,845	164	306
Total.....	302,115	779	3,662	795	1/ 28,427	171	332

1/ Of this number, 435 were mules.

Supervision over the importation of hides and other animal byproducts, forage, etc: In the fiscal year 1944 control was exercised over the entry of various animal byproducts, including approximately 93,000,000 hides and skins of which more than 4,000,000 were transported to and handled at destination establishments under supervision. A total of 1,399 railway cars and a large number of trucks and ship compartments used in transportation of restricted import products were disinfected, as well as premises involved in the handling of these products.

Inspection and testing of animals for export: During the fiscal year 1944, 26,026 animals were inspected prior to their exportation in compliance with the regulations of the Department and in order to meet the requirements of destination countries. These included 10,193 cattle, 8,911 swine, 2,627 sheep, 171 goats, 1,490 horses, 2,597 mules, 35 donkeys, and 2 other animals.

Eradicating cattle ticks: At present, the principal activities are in Texas and Puerto Rico, while control activities and check inspections are being continued in Alabama, Arkansas, California, Florida, and Louisiana. In Texas, the principal activities are in a narrow strip of quarantined territory extending through parts of 8 counties along the lower Rio Grande from Del Rio to the Gulf of Mexico. Mexican territory adjacent to this area is tick infested and this quarantined strip is being maintained as a buffer in an effort to control the introduction of ticks on smuggled or straying animals from Mexico. In Puerto Rico it has been necessary to continue an extensive dipping program to cope with scattered infestation in many sections of that island. In the States of Alabama, Arkansas, California, Florida, and Louisiana, the work consists of reinspection whenever tick infestation is suspected or reported and taking necessary control measures.

In this work, cooperating agencies during the past fiscal year supervised 8,604,776 inspections or dippings of cattle, 700,602 inspections

or dippings of horses and mules, and 558,678 inspections or dippings of sheep and goats.

Hog-cholera control: During the fiscal year ending June 30, 1944, through their visits to farms and attendance at meetings, specially trained veterinarians had opportunity for 46,603 farm inspections and consultations relating to swine diseases with farmers, veterinarians, state officials, and others. Educational work was continued by these veterinarians, who attended 220 meetings at which there was an attendance of 12,538 persons. During the year 5,059 outbreaks of cholera were reported to these veterinarians. These measures have greatly reduced losses from hog cholera and have prevented widespread outbreaks of this disease.

Enforcement of the 28-hour law (Office of Distribution): The volume of work under the 28-hour law is measured by the number of alleged violations brought to the attention of the Department. Violations for the past four years are shown in the following table:

Item	Fiscal Year			
	1941	1942	1943	1944
Violations reported	244	757	1,916	2,138
Violations referred to Solicitor	182	504	613	795
Violations referred to Department of Justice	217	473	442	866
Cases terminated during year	121	299	511	542
Cases pending end of year	154	328	256	773
Number of convictions	117	280	455	490
Amount of penalties	\$11,875	\$29,750	\$48,050	\$53,600

As in fiscal year 1943, official inspections of stockyards and railway yards were discontinued because of the pressure of work caused by the large number of violations reported. Previously, inspection of stockyards and consultations with railroad officials resulted in many improvements in facilities for feeding, watering, and resting livestock while in transit.

To meet the requirements of the 28-hour law and to overcome the effects of delays incident to heavy wartime traffic on their lines, the carriers have developed and put into use facilities for resting, watering, and feeding animals at points not generally used as rest stations in the past. These additional feeding stations enroute to market have made it possible for the animals to arrive at destination in better condition than when confined in cars for long periods of time. This has resulted in a reduction in shrinkage and a corresponding saving in meat products.

(h) Meat Inspection

Appropriation Act, 1945	\$9,359,124
Proposed transfer in 1946 estimates from "Salaries and expenses, animal industry, Agricultural Research Administration", general administrative expenses	+47,000
Total available, 1945	9,406,124
Budget estimate, 1946	7,800,000
Change for 1946:	
Overtime decrease	-1,605,435
Other decrease	-689
	<u>-1,606,124</u>

PROJECT STATEMENT

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
Office of Disbribution:				
1. Meat inspection opera-				
tions at packing plants				
under the Federal meat in-				
spection service.....	\$6,996,568	\$7,650,809	\$7,650,120	-\$689(1)
2. Determinations of adul-				
terations and other objec-				
tionable conditions in meat				
and meat food products by				
laboratory analysis	86,991	92,350	92,350	- -
3. Inspection of imported				
meats and meat food products:	29,172	30,100	30,100	- -
4. Overtime costs	1,473,004	1,601,035	- -	-1,601,035
Unobligated balance	31,999	- -	- -	- -
Total available, Office				
of Distribution	8,617,734	9,374,294	7,772,570	-1,601,724
Bureau of Animal Industry:				
5. Chemical, pathological,				
and zoological investiga-				
tions relating to meat				
inspection	24,781	27,430	27,430	- -
6. Overtime costs	3,915	4,400	- -	-4,400
Unobligated balance	3,134	- -	- -	- -
Total available, Bureau				
of Animal Industry ..	31,830	31,830	27,430	-4,400
Total available	8,649,564	9,406,124	7,800,000	-1,606,124
Received by transfer from				
"Salaries and expenses,				
animal industry, Agricul-				
tural Research Administra-				
tion," eradicating tuber-				
culosis and Bang's disease:	-418,866	- -	- -	
Total estimate or				
appropriation	8,230,698	9,406,124	7,800,000	

INCREASES OR DECREASES

The net decrease of \$1,606,124 in this item for 1946 consists of the \$1,605,435 decrease for overtime, and a decrease of \$689 to round off the appropriation total.

CHANGE IN LANGUAGE

The estimates include a proposed change in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

Meat inspection: For carrying out the provisions of laws relating to Federal inspection of meat and meat food products, [including the purchase of printed tags, labels, stamps, and certificates without regard to existing laws applicable to public printing, \$9,359,124], \$7,800,000

It is recommended that the language authorizing the purchase of printed tags, labels, etc., without regard to existing printing laws be deleted since provision therefor is now contained in Sec. 101 (f) of the Department of Agriculture Organic Act of 1944, Public Law 425, approved September 21, 1944.

WORK UNDER THIS APPROPRIATION

Objective: (1) To insure that meat and meat products flowing into interstate or foreign commerce, or destined for use by Federal agencies are sound, wholesome and otherwise fit for human consumption; (2) to facilitate the purchase of meat and meat food products by Federal agencies by providing Federal meat inspection during the present emergency for meat-packing establishments engaged in intrastate commerce only; (3) to insure sanitary preparation and handling of foods composed entirely or in part of meat; (4) to prevent false and deceptive labelings; (5) to implement and facilitate the eradication and control of contagious diseases of livestock; and (6) to assure proper post-mortem diagnosis and disposition of carcasses in unusual cases; to conduct research on methods of treatment of carcasses and tissues to meet requirements of meat inspection regulations; and to conduct research on abnormal conditions in meat or its products through investigations of suspected feeding, management, or packing procedures or of diseases or parasites to which the conditions might be attributed.

The Problem and Plan of Work:

(1) In connection with Meat Inspection Service: The Meat Inspection Service has for many years been an important and fundamental influence in the marketing and distribution of livestock and livestock products. Wartime needs for meat and meat products have raised many problems with respect to the standardization work, and specifications for the preparation of food for the armed services and our Allies. Highly trained experts of the Meat Inspection Service have been of inestimable value in the solution of many of these problems and, in addition, have assumed the actual supervision of the preparation of meat and meat food products. The number of animals slaughtered and the volume of such products prepared under inspection during the fiscal year 1944

reached the highest level in the history of the service, and will continue at this high level throughout the war. Since meat and meat products are highly perishable, and approximately 7 $\frac{1}{2}$ percent of all animals slaughtered are affected with some degree of abnormality which is seldom obvious except to especially trained inspectors, it is necessary to closely supervise all stages of processing, preparing, and packing. With demand for meat and meat products at an all-time high, insanitary and improper processing methods which give rise to waste cannot be tolerated.

As a means of enlarging the supply of inspected meat and meat food products for purchase by the Army, Navy, Lend-Lease, and other Federal agencies, the Act of June 10, 1942 provided for the extension, during the present emergency, of Federal Meat Inspection to qualified meat packing establishments engaged only in intrastate commerce. As a result of this extension, the number of establishments operating under Federal inspection increased from 679 in 1942 to 944 in 1944, an increase of 39 percent.

To prevent contamination, any ingredients of meat products such as cereals, spices, and other seasoning added during the processing, must also be inspected for wholesomeness and proper use. Condemned meat or condemned meat products must be destroyed under strict supervision so as to prevent other meats and meat products from becoming contaminated.

All trade labels used at inspected establishments must be approved in advance and must include certain mandatory information stating that the finished products are truthfully and informatively labeled.

Under the Import Meat Act and the Meat Inspection Acts, the Secretary of Agriculture may determine what meat and meat products may be offered for import by countries having a national system of inspection which is the substantial equivalent of the system maintained in the United States. Each consignment is carefully inspected to ascertain that only meat and meat products which have been properly certified from abroad are accepted and that they are sound, wholesome, and otherwise fit for food and truthfully labeled. This prevents the importation of any diseased or contaminated meat or meat products. Meat or meat products destined for export are inspected to insure that the quality is sufficiently high to maintain the integrity of our products on foreign markets.

(2) In connection with related research: It is imperative that proper diagnosis be made of diseased or other questionable conditions encountered in food-producing animals at the time of slaughter. This prevents the distribution of any unwholesome meat or meat products to the general public or to our armed forces and Allies and assists in the conservation of our meat supply. To accomplish this, an immediate investigation is required of unusual biochemical, pathological, and zoological conditions or symptoms which inevitably arise. It has not been necessary to establish special laboratories for this purpose inasmuch as highly specialized facilities which may be utilized with a minimum of cost and a maximum of efficiency have been available for many years in the Bureau of Animal Industry.

Examples of Progress and Current Programs:

Meat inspection operations at packing plants: At the close of the fiscal year there were 449 federally inspected establishments in which slaughtering operations were conducted with or without the processing of meat and 415 inspected establishments in which meat processing operations only were conducted. In addition there were 21 establishments under inspection which slaughtered cattle only for the Army and 23 establishments which prepared fresh boneless meat under specifications for Federal agencies. The preparation of meat for Lend-Lease requirements and the armed forces continued at a number of official establishments with a volume somewhat greater than during the previous year.

The number of establishments and cities and towns where Federal meat inspection has been conducted during the past four years is as follows:

<u>Fiscal Year</u>	<u>Establishments</u>	<u>Cities & Towns</u>
1941	668	257
1942	679	264
1943	842	336
1944	944	363

Animals inspected ante-mortem and post-mortem: The increase in the volume of ante-mortem and post-mortem inspections of animals slaughtered for the past five years is reflected in the following tables:

Ante-mortem inspection							
Fiscal Yr:	Passed	:	Suspected	:	Condemned	:	Total
1940	: 78,527,862	:	216,671	:	27,208	:	78,771,741
1941	: 81,818,138	:	243,005	:	31,763	:	82,092,906
1942	: 85,777,095	:	251,804	:	34,291	:	86,063,190
1943	: 95,156,504	:	248,981	:	43,511	:	95,448,996
1944	: 117,769,389	:	276,458	:	55,789	:	118,101,636

<u>Post-mortem inspection</u>					
<u>Fiscal Yr:</u>	<u>Passed</u>	:	<u>Condemned</u>	:	<u>Total</u>
1940	: 78,527,801	:	223,548	:	78,751,349
1941	: 81,799,343	:	262,848	:	82,062,191
1942	: 85,749,940	:	278,012	:	86,027,952
1943	: 95,082,760	:	320,778	:	95,403,538
1944	: 117,656,285	:	387,774	:	118,044,059

Ante-mortem and post-mortem inspections of animals during the fiscal year 1944:

Kind of Animal :	Ante-mortem inspection				Total
	Passed	Suspected	Condemned		
	Number	Number	Number	Number	
Cattle	12,804,075	112,043	6,342		12,922,460
Calves	6,262,795	10,816	6,537		6,280,148
Sheep & Lambs...	23,826,841	11,199	14,107		23,852,147
Goats	10,492	11	21		10,524
Swine	74,804,827	142,245	28,587		74,975,659
Horses 2/.....	60,359	144	195		60,698
			3/		
Total	117,769,389	276,458	55,789		118,101,636

- 1/ "Suspected" is used to designate animals suspected of being affected with disease or condition that may cause condemnation in whole or in part on special post-mortem inspection.
- 2/ Horses are slaughtered and their meat handled and prepared in establishments separate and apart from those in which cattle, calves, sheep, goats, and swine are slaughtered and their meat handled and prepared.
- 3/ Includes 2,267 previously suspected animals which died in pens.

Kind of Animal :	Post-mortem inspection				Total
	Passed	Condemned			
	Number	Number		Number	
Cattle	12,843,101	72,563			12,915,664
Calves	6,236,117	37,420			6,273,537
Sheep & Lambs...	23,725,424	112,313			23,837,737
Goats	10,454	49			10,503
Swine	74,782,057	164,060			74,946,117
Horses 1/.....	59,132	1,369			60,501
Total	117,656,285	387,774			118,044,059

- 1/ Horses are slaughtered and their meat handled and prepared in establishments separate and apart from those in which cattle, calves, sheep, goats, and swine are slaughtered and their meat handled and prepared.

Labeling: During the year 11,538 new labels were approved for use at inspected establishments. There were also approved 110 labels for meat and meat food products intended for importation into this country. In addition, several thousand sketches of labels were presented for approval; 1842 of these were returned because of noncompliance with labeling requirements.

Tests for adulteration and wholesomeness of 29,378 samples of meat, meat food products, and ingredients and substances used in their

preparation were made during 1944 compared with 29,609 in 1943. A little over 3,000 of the 1944 samples examined resulted in adverse findings as compared with 4,505 in 1943.

During 1944, 561 sets of drawings and sketches for construction and remodeling of processing plants and for major equipment installations were submitted; 311 of these sets were approved. These were examined primarily to insure (1) that the proposed construction facilitated sanitary maintenance; (2) that equipment was of suitable type and so arranged that operations could be conducted in a clean and otherwise acceptable manner; and (3) that the facilities provided were suitable for efficient inspection.

Processed meat and meat food products: The volume of meat and meat food products prepared and processed under Federal supervision rose from 14,292,716,225 pounds during the fiscal year 1943 to 16,707,585,974 pounds during the fiscal year 1944 - an increase of 17 percent. There is shown below the total volume supervised during the 5-year period 1940-1944:

<u>Fiscal Year</u>	<u>Pounds</u>
1940	9,690,165,254
1941	10,514,837,866
1942	12,039,492,563
1943	14,292,716,225
1944	16,707,585,974

The two following tables indicate in detail for the fiscal years 1943 and 1944 (1) the types of meat and meat food products prepared and processed under supervision during the fiscal years 1943 and 1944 and (2) the quantities of such meat and meat food products condemned on reinspection and destroyed for food purposes on account of having become sour, tainted, rancid, unclean, or otherwise unfit for human food.

Meat and Meat Food Products: Prepared and Processed under Supervision,
Fiscal Years 1943 and 1944

Product	1943	1944
	Quantity (Pounds)	Quantity (Pounds)
Placed in cure:		
Beef	124,590,795:	134,123,636
Pork	3,354,027,875:	4,033,981,189
Smoked and/or dried:		
Beef	48,222,091:	53,160,412
Pork	2,019,246,816:	2,367,808,744
Sausage:		
Fresh, finished	309,945,869:	400,669,726
Smoked and/or cooked	928,154,196:	986,095,209
To be dried or semidried	131,048,932:	138,249,645
Loaf, headcheese, chili con carne, jellied products, etc.	225,502,714:	212,307,595
Cooked meat:		
Beef	17,971,968:	35,226,730
Pork	284,498,807:	485,662,979
Canned meat and meat food products:		
Beef	150,275,165:	134,938,998
Pork	1,177,275,699:	995,723,680
Sausage	314,683,723:	215,572,407
Soup	217,521,385:	286,095,549
All Other	599,700,312:	489,267,128
Bacon, sliced	393,219,287:	560,282,295
Lard:		
Rendered	1,607,659,145:	2,339,028,779
Refined	1,376,701,158:	1,804,245,765
Rendered pork fat:		
Rendered	193,801,803:	255,208,641
Refined	114,215,182:	141,102,201
Oleo stock	146,176,965:	148,565,173
Edible tallow	110,735,574:	104,238,280
Compound containing animal fat	352,303,865:	255,810,912
Oleomargarine containing animal fat	60,057,659:	59,965,997
Miscellaneous	28,576,409:	60,018,956
Horse Meat:		
Chopped	6,602,831:	10,235,348
Total	1/ 14,292,716,225:1/	16,707,585,974

1/ This figure represents inspection pounds. Some of the products may have been inspected and recorded more than one due to having been subjected to more than 1 processing treatment, such as curing first and then canning.

Meat and Meat Food Products Condemned on Reinspection

Product	Fiscal Year	
	1943 (Pounds)	1944 (Pounds)
Beef	3,200,189:	3,755,516
Pork	8,153,021:	9,644,507
Mutton	127,783:	169,479
Veal	48,395:	83,002
Goat Meat	102:	381
Horse Meat	91,965:	15,981
Total	11,621,455:	13,668,866

Specification examination. Federal agencies who purchase meat and meat products require that it be examined for compliance with particular specifications as well as for wholesomeness and soundness. This work is done on a reimbursable basis. The total volume of meat and meat food products examined for other government agencies reached a record high during the year as indicated by the following table:

Branch of Government	F. Y. 1942 (Pounds)	F. Y. 1943 (Pounds)	F. Y. 1944 (Pounds)
Navy Department	347,678,698:	671,830,601:	494,766,677
Commodity Credit Corporation (Lend-Lease)...	- -:	- -:	292,123,169
Coast Guard	2,888,000:	6,117,028:	12,649,763
War Shipping Administration .	- -:	3,614,129:	3,912,419
Marine Corps	15,466,547:	73,685,214:	823,376
Department of Interior	1,373,095:	870,600:	708,556
Veterans Administration	6,228,052:	1,590,133:	620,825
War Department	668,468:	357,035:	279,224
Maritime Commission	252,829:	207,900:	209,052
Department of Justice	3,073,283:	1,234,263:	122,168
All Others	14,318,020:	14,366,252:	- -
Total	391,946,992:	773,873,155:	806,215,229

Certificates of exemption. Under the Meat Inspection Act, retail butchers and dealers who normally deal in meats in intra-state commerce only and who desire to make inter-state shipments may do so by obtaining exemption certificates. These exemptions apply only to the inspection operations themselves and do not release the butchers or dealers from conforming to such requirements as soundness and wholesomeness of products. Periodic inspections are made of the premises of such dealers and butchers to assure that the meat and meat products are produced under sanitary conditions and that meat inspection requirements are met.

A total of 47 certificates of exemption from inspection were issued in 1944 while a total of 219 outstanding certificates were cancelled.

Prosecutions. Successful prosecutions of 25 violations of the Meat Inspection Act were made in 1944.

Chemical, pathological and zoological investigations relating to meat inspection (Bureau of Animal Industry): Several hundred specimens were received from the Meat Inspection Division of the Office of Distribution from various parts of the country. Diagnoses were made and proper disposition was made of the meat of the animals from which the specimens were obtained.

Experiments were conducted to determine the effects of low temperatures on the vitality of trichinae in cured pork. Boneless butts were cured--one lot for 7 days and another for 14 days. Following curing they were placed in a freezer the temperature of which ranged from 7° to 10°F. In the pork cured for only 7 days live trichina larvae were found after 7 days of freezing but not after 10 days; in pork cured for 14 days live larvae were no longer present even after 2 days of freezing. In tests to determine the effects on trichina larvae of holding ground salted pork, it was found that when salt at the rate of 3-1/3 pounds per hundred pounds of ground pork was added the trichinae were killed when the meat was held in a cooler (about 34° to 38°F) for 42 days. When the meat was held in a freezer (7° to 10°F), live larvae were still present after 12 days but not after 15 days.

An investigation was begun to obtain precise information on the degree of heat necessary to kill tapeworm cysts in beef. It was determined that the vitality of these parasites was destroyed by a temperature of 140° F, provided this temperature was gradually attained as would be the case in ordinary slow cooking. Shorter exposures, as in the case of rapid cooking required temperatures much higher than 140° F to destroy tapeworm cysts.

(i) Virus Serum Toxin Act

Appropriation Act, 1945	\$279,228
Proposed transfer in 1946 estimates from "Salaries and expenses, animal industry, Agricultural Research Administration," general administrative expenses	+8,000
Total available, 1945	<u>287,228</u>
Budget estimate, 1946	<u>243,400</u>
Change for 1946:	
Overtime decrease ... -43,793	
Other decrease -35	<u>-43,828</u>

PROJECT STATEMENT

Project	1944	1945 :(estimated):	1946 :(estimated):	Increase or decrease
1. Control of manufacture, importation and shipment of viruses, serums, toxins, etc.	\$229,848:	\$243,435:	\$243,400:	-\$35 (1)
2. Overtime costs	42,181:	43,793:	- -	-43,793
Unobligated balance	786:	- -	- -	
Total estimate or appropriation (1944 and 1945 adjusted for comparability)	272,815:	287,228:	243,400:	

INCREASES OR DECREASES

- (1) The decrease in this item for 1946 consists of the \$43,793 decrease for overtime, and a decrease of \$35 due to a rounding off of the appropriation total.

WORK UNDER THIS APPROPRIATION

Objective: To insure that all veterinary biologics produced by licensees are, in fact, not worthless, contaminated, dangerous, or harmful, and to prevent insofar as possible, the interstate movement or importation of any veterinary biologic product, organism, or vector that is worthless, contaminated, dangerous, or harmful.

The Problem and its Significance: Biological products that are not properly prepared and tested may be worthless, contaminated, dangerous, or harmful to animals treated therewith. They may either fail to prevent or control an outbreak of disease and may even be the means of spreading disease. A license issued by the Secretary should carry with it reasonable assurance to the livestock producer that the products when properly used will afford protection and not be harmful to his animals. A biologic that is contaminated or otherwise

improperly prepared, not only may endanger the herd that is treated, but may prove disastrous to other herds in the community through failure of the product in some respect.

General Plan: This work entails the detailing of sufficient inspectors to the establishments producing anti-hog-cholera serum and hog-cholera virus so that all operations connected with the production and testing of these products are carried out under direct supervision. Inspection of plants producing biological products other than anti-hog-cholera serum and hog-cholera virus is made periodically or upon instructions for special reasons.

Examples of Progress and Current Program: This work continues to have an important relation to the prosecution of the war as maximum supplies of livestock and their derivatives cannot be expected unless properly prepared biological products are available which will safeguard livestock and poultry against hog cholera, anthrax, black-leg, encephalitis, fowlpox, and the like. The quantity of anti-hog-cholera serum and hog-cholera virus and other biologics as shown in the following table furnishes a reliable indication of the activities under this appropriation:

	Actual F. Y. 1944	Estimated F. Y. 1945 and F. Y. 1946 (each year)
(a) Establishments producing anti-hog-cholera serum and hog-cholera virus	40	40
Production:		
Serum (cc)	2,034,080,536	1,932,376,000
Virus (cc)		
Simultaneous	120,436,659	127,207,000
Hyperimmunizing	413,712,495	384,527,000
Inoculating	1,936,902	1,641,000
Animal inspections	5,863,269	5,647,000
Tests supervised	18,448	21,320
(b) Establishments producing other biologics	40	40
Production:		
Cc	435,632,000	583,911,000
Milligrams	33,411,000	33,571,085
Disks	625,000	1,208,000
(c) Products destroyed (all Kinds) :		
Cc	26,895,000	36,255,000
Milligrams	5,028,000	3,439,000
Disks	57,000	11,753
(d) Export certificates issued	509	518

(j) Marketing Agreements, Hog Cholera Virus and Serum

Appropriation Act, 1945	\$38,444 (a)
Budget estimate, 1946	<u>31,940 (a)</u>
Change for 1946:	
Overtime decrease ... -6,504	
No other change - -	<u>-6,504</u>

- (a) Transferred from the unobligated balance of the appropriation provided by section 12(a), Title I, of the Agricultural Adjustment Act of May 12, 1933.

CHANGE IN LANGUAGE

The estimates include a proposed change in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

Marketing [agreements with respect to] agreements, hog cholera virus and serum: The sum of [~~\$38,444~~] \$31,940 of the appropriation made by section 12(a) of the Agricultural Adjustment Act, approved May 12, 1933, * * * *.

The change in language deletes the words "with respect to" for the sole purpose of simplifying and shortening the title of the item.

WORK UNDER THIS APPROPRIATION

Objective: To insure that the control agency and handlers of anti-hog-cholera virus observe the provisions of the marketing agreements and order.

The Problem and its Significance: The Serum and Virus Law of August 24, 1935, and Marketing Agreement of December 7, 1936, stress the economical importance of producers and other handlers maintaining an adequate supply of serum and virus at all times, and aim to prevent undue and excessive fluctuations of prices, unfair methods of competition, and unfair trade practices.

General Plan: The marketing agreement is enforced by a control agency selected by the Secretary and handlers, whose acts are subject to review by the Secretary and his representatives. The work relates mainly to reviewing acts of the control agency, attendance at meetings, and the assembling of economic data relating to the production, sales, and prices of anti-hog-cholera serum and hog-cholera virus. Proposed amendments to the agreement and order have entailed conferences and public hearing for the purpose of receiving testimony and affording all interested parties the opportunity to file briefs.

Examples of Progress and Current Program: At the close of the fiscal year 1944, there were 244 handlers of anti-hog-cholera serum and virus operating under the marketing agreement, an increase of 2 over the previous fiscal year.

(k) Eradication of Foot-and-Mouth
and Other Contagious Diseases of Animals

This item continues the availability of \$305,000 of the unexpended balances of appropriations heretofore made for use in case of an emergency arising from an outbreak of foot-and-mouth or other contagious diseases of animals. It provides also that \$5,000 of this balance may, if needed, be used for the control of European fowl pest and similar diseases in poultry. No expenditures are contemplated unless an emergency arises, but it is essential that funds be available at all times to insure immediate protection of the American livestock industry should outbreaks occur. This is particularly important under present world conditions when most countries are at war. In many of them there has been a complete breakdown of livestock sanitary requirements.

CHANGES IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

In case of an emergency arising out of the existence of foot-and-mouth disease, rinderpest, contagious pleuropneumonia, or other contagious or infectious diseases of animals, which, in the opinion of the Secretary, threatens the livestock industry of the country, he may expend in the city of Washington or elsewhere any unexpended balances of appropriations heretofore made for this purpose, not to exceed \$305,000, in the arrest and eradication of any such disease, including the payment of claims growing out of past and future purchases and destruction, in cooperation with the States, of animals affected by or exposed to, or of materials contaminated by or exposed to, any such disease, wherever found and irrespective of ownership, under like or substantially similar circumstances, when such owner has complied with all lawful quarantine regulations: Provided, That the payment for animals hereafter purchased may be made on appraisement based on the meat, dairy, or breeding value, but in case of appraisement based on breeding value no appraisement of any animal shall exceed three times its meat or dairy value, and, except in case of an extraordinary emergency, to be determined by the Secretary, the payment by the United States Government for any animals shall not exceed one-half of any such appraisements: Provided further, That [the sum of] of said \$305,000 not to exceed \$5,000 [of the unexpended balance of the appropriation of \$3,500,000 contained in the Second Deficiency Appropriation Act, fiscal year 1924, approved December 5, 1924, for the eradication of the foot-and-mouth disease and other contagious or infectious diseases of animals, is hereby made available during the fiscal year for which appropriations are herein made to enable the Secretary] may be used to control and eradicate the European fowl pest and similar diseases in poultry.

It is recommended that the language in the second proviso repeating reference to the unexpended balance of the appropriation in the Second

Deficiency Act, fiscal year 1924, for eradication of foot-and-mouth disease be deleted in the interest of shortening and simplifying the wording of this item.

(1) Special Research Fund, Department of Agriculture
(Allotment to Bureau of Animal Industry)

This budget schedule covers obligations under an allotment for special research projects and four regional research laboratories located at Auburn, Alabama, for study of the mechanism of infection in the contagious, infectious and parasitic diseases of livestock and poultry; Dubois, Idaho, for the improvement of sheep for Western ranges through the application of breeding methods; Ames, Iowa, for the improvement of swine through the application of breeding methods; and East Lansing, Michigan, for the improvement of viability in poultry.

(m) Working Funds (Bureau of Animal Industry)

This budget schedule covers obligations for the fiscal year 1944 under advances, pursuant to Section 601 of the Economy Act of June 30, 1932, for services performed for various agencies as indicated in the following statement of obligations under supplemental funds.

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS
(1944 and 1945 figures include overtime costs)

Item	: : Obliga- : tions, : 1944	: Estimated: : obliga- : tions, : 1945	: Estimated: : obliga- : tions, : 1946
Special Research Fund, Department of Agriculture:	:	:	:
Special research projects	36,738:	35,960:	30,866
Special research laboratories in major agricultural regions	303,976:	303,834:	277,344
Total, Special Research Fund	340,714:	339,794:	308,210
Working Funds, (Bureau of Animal Industry, Agriculture) Advances from:	:	:	:
Office of Scientific Research and Development: Investigations of reduction in bulk and weight of the ration for army horses	6,717:	- -	- -
War Department: Research to develop the best material available to date for sleeping bag fillers with particular reference to treated chicken and turkey feathers	7,490:	- -	- -
Total, Working Funds	14,207:	- -	- -
Total, Obligations under Supplemental Funds	354,921:	339,794:	308,210

PASSENGER-CARRYING VEHICLES

The amount included for the fiscal year 1946 (\$140,000) will permit the Bureau to replace 175 old vehicles at an average net cost of \$800. This is about 27 percent of the Bureau's cars. Of the 641 Bureau passenger-carrying vehicles now in operation, nearly 95 percent are used in inspection work on farms in rural districts. It has been the Bureau's experience that cars assigned to rural inspection work receive such rough use on secondary and country roads and lanes leading to farms that they normally would be replaced about every three years, in order to keep mileage costs at the lowest possible point, and to prevent frequent interruptions to the work which occur due to breakdowns when badly worn equipment is kept in service. However, under present conditions it is imperative to use cars as long as possible, even though an earlier replacement would be more economical. Every means possible is being used to extend the life of all cars. All the cars to be replaced have reached the point where they can no longer be kept in service, the average mileage being approximately 40,000 and in individual cases running as high as 60,000.

The Bureau is unable to carry on economically and efficiently its varied activities in the field by the use of public transportation. Therefore, when government-owned cars are not available, it is necessary to authorize employees to operate their privately-owned cars on a mileage basis. The Bureau has found that in normal times the use of government-owned passenger-carrying vehicles for transporting its employees is considerably less expensive than when employees are reimbursed for the use of their own cars.

/ PENALTY MAIL
Section 2, Public Law 364, 78th Congress
(Allotment to Bureau of Animal Industry)

	<u>Category 1</u>	<u>Category 2</u>	<u>Total</u>
1945	\$267	\$20,273	\$20,540
1946	267	22,263	22,530
Change	- -	+1,990	+1,990

Category 1 consists of bulletins and leaflets in connection with the work of the Bureau sent in reply to specific inquiries for information, and for mailing new publications which may be issued on foot-and-mouth diseases, Bang's disease, hog cholera control, etc., to field employees and to individuals cooperating with the Bureau.

Category 2 consists of general administrative correspondence between Washington and the field stations located throughout the 48 States and the mailing of vouchers, payrolls, and other operating documents, etc. Also included in this category are cards and letters from field stations to farmers asking them to have their cattle ready for testing and announcing results of tests.

The increase of \$1,990 for 1946 is based on an estimated increase in the mailing of administrative material in connection with the increase in funds of \$455,449 to cover additional operating expenses and indemnity payments incident to overdue retests of cattle under "Eradicating Tuberculosis and Bang's Disease." There will also be an increase in the number of cards and letters from field stations to farmers asking them to have their cattle ready for testing and announcing results of tests.

BUREAU OF DAIRY INDUSTRY

(a) Salaries and Expenses

Appropriation Act, 1945	\$812,958
Budget estimate, 1946	<u>742,300</u>
Change for 1946:	
Overtime decrease	-90,658
Increase	<u>+20,000</u>
	<u>-70,658</u>

PROJECT STATEMENT

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
1. Investigations of in- fluence of breeding, feeding and management practices on efficiency of production	\$329,207	\$323,760	\$343,760	+\$20,000 (1)
2. Investigations of the nutritional and other physiological factors affecting the usefulness of dairy cattle	106,770	114,358	114,358	- -
3. Investigations of dairy- herd-improvement asso- ciation practices in re- lation to efficiency of production	119,592	126,726	126,726	- -
4. Investigations of milk: and milk products	137,617	151,944	151,944	- -
5. Administration and en- forcement of the Process: (or Renovated) Butter Act (regulatory)	5,236	5,512	5,512	- -
6. Overtime costs	90,605	90,658	- -	-90,658
Unobligated balance	16,293	- -	- -	- -
Total available	<u>805,320</u>	<u>812,958</u>	<u>742,300</u>	<u>-70,658</u>
Transferred to "Salaries and expenses, Office of Information, Department of Agriculture"	+400	- -	- -	
Total estimate or appropriation	<u>805,720</u>	<u>812,958</u>	<u>742,300</u>	

INCREASES OR DECREASES

The net decrease of \$70,658 in this item for 1946 consists of the \$90,658 decrease for overtime, and the following:

- (1) An increase of \$20,000 under the project "Investigations of influence of breeding, feeding and management practices on efficiency of production" to increase the size of the Holstein herd at the Agricultural Research Center at Beltsville, Maryland.

Objective: To accelerate research dealing with the fixing of inheritance for high levels of milk and butterfat production through the use of proved meritorious sires, by developing larger progeny groups of each proved sire used.

The Problem and its Significance: The theory has been advanced that a good proved sire is one that approaches purity for the hereditary factors determining the characteristics being developed, such, for example, as high levels of milk and butterfat production in dairy cattle; that if the good proved sires within a given breed possess the same hereditary makeup and if such sires could be used for generation after generation it might be possible to breed a strain that approaches purity for the factors determining high levels of production, in which case all of the progeny would also possess this hereditary ability for high production. If this theory is correct and sires can be successfully selected for a given characteristic, a real opportunity would present itself for attaining purity without resorting to the dangerous practice of close inbreeding, which might result in depressed production and vigor and lowered breeding efficiency.

If, therefore, as a result of the use of proved, meritorious sires for a number of generations it is possible to produce a strain that approaches purity for the factors determining high levels of production, all offspring from a mating in that strain could be relied upon to possess an inheritance that will enable them to be either high producers or transmitters of high production. A herd that uses a series of young sires from such a strain can be sure of improvement as long as environmental conditions are such as to permit the herd to produce up to its hereditary capacity. That progress can be made by this method of breeding is shown by the fact that production data on the herds of 15-farmer cooperators who used a series of 3 or more station bred bulls, showed an increase in production level of approximately 36 percent.

Plan of Work: It is proposed to enlarge the size of the experimental herd by retaining a larger number of females to an advanced age than has heretofore been possible. This will make it possible to secure a larger progeny group by each proved sire, thus permitting the introduction of new sires more frequently and speeding up the progress of the experimental work. It should result in the development of a better germ plasm for dissemination throughout the dairy industry, possibly through the technique of artificial insemination.

CHANGES IN LANGUAGE

The estimates include proposed changes in language of this item as follows (new language underscored, deleted matter enclosed with brackets):

Salaries and expenses: For necessary expenses, including not to exceed [~~\$410,345~~] \$332,325 for personal services in the District of Columbia, of the Bureau of Dairy Industry in carrying out the provisions of the Act of May 29, 1924 (7 U.S.C. 401-404), including investigations, experiments, and demonstrations in dairy industry, cooperative investigations of the dairy industry in the various States, for carrying out the applicable provisions of the Acts of May 9, 1902 (26 U.S.C. 2325, 2326 (c), 2327 (b)), and August 10, 1912 (26 U.S.C. 2327 (c)), relating to process or renovated butter, and the Act of May 23, 1908 (21 U.S.C. 94 (a)) [,] insofar as it relates to the exportation of process or renovated butter, [repairs to buildings, and not to exceed \$10,000 for the construction or alteration of buildings, \$812,958] \$742,300.

The first change deletes a comma in the interest of clarity. The comma, which was not contained in the 1944 appropriation language nor in the 1945 Budget, was inadvertently included in the 1945 act.

The second change proposes deletion, from this item, of the authority to repair, construct or alter buildings. Provision for construction, repair, and alteration of buildings is now contained in the 1946 Budget language under the Office of the Research Administrator for all bureaus, offices, and items of the Agricultural Research Administration. The language proposed to be deleted from this item is, therefore, unnecessary.

WORK UNDER THIS APPROPRIATION

Objective: To increase the milk and butterfat producing efficiency of the Nation's dairy cows; to improve the quality of products made from milk; to effect greater efficiency in manufacturing methods, and to develop new milk products and provide for the more efficient utilization of milk byproducts.

The Problem and its Significance: There are about 26 million cows in the United States kept for milking purposes. The average butterfat production of the cows is only 188 pounds a year, which is too low for profit. Only one-third of these cows actually return a profit to their owners. Methods of selecting and breeding must be devised whereby 90 percent or more of the animals raised for dairy purposes will possess an inheritance for profitable production.

The national dairy herd must be fed in a manner that will maintain the health of the animals and insure economical production of milk and butterfat, and at the same time result in the production of milk with a maximum of nutritive and health-giving properties. Research is required to determine the most economical methods of feeding for milk production under the various conditions of feed supplies and prices that may occur;

and to determine the relation of the cow's diet to her health and reproductive functions and also to the nutritive properties of the milk produced.

Quality control in the manufacture of dairy products is possible only through a knowledge of the bacteriological and chemical changes involved and the application of this knowledge to factory processes. This requires research to provide the basis for formulas and rules applicable to factory conditions. Defects in quality are usually the result of insufficient knowledge of the factors influencing flavor or texture and of the methods controlling these factors under commercial conditions.

General Plan: The work is carried on through field and laboratory experiments in cooperation with state colleges, agricultural experiment stations, and extension services, other Government agencies, dairymen, and manufacturers of dairy products. Some phases of the work are conducted cooperatively in each State and in Hawaii and Puerto Rico. Breeding experiments are conducted to ascertain the comparative effects of different methods of breeding in fixing an inheritance for high and uniform levels of producing ability in dairy cows; to develop methods for judging at an early age the potential producing ability of heifers in order to avoid raising to maturity those heifer calves that should be discarded because of inferior milk-producing ability. Other phases of the production research are the effect of nutrients on growth, reproduction, health, and yield and composition of milk, and the effect of the application of breeding and feeding practices on the level and economy of production.

Examples of Progress and Current Program: The following are examples of recent accomplishments under this appropriation.

Investigations of the influence of breeding, feeding and management practices on efficiency of production:

Levels of production raised by breeding experiments. Definite progress is being made in the experiments in which meritoriously proved sires are used for generation after generation in fixing an inheritance for high levels of production.

Data from dairy-herd-improvement associations and other sources indicate generally that for every bull the dairy farmer buys that improves the production of his herd, he also gets one that lowers production. As a result he makes no progress in improving the hereditary ability of his cattle for better production. On the other hand, 85 percent of the bulls from the superior strains developed in the experimental herds of the Bureau of Dairy Industry have improved the production level in the herds in which they were used. On the average, each daughter has produced 38 pounds more butterfat per year than her dam. There are now some 300 bulls from experimental herds in farmer-owned and institutional herds. A cooperative relationship has been established under which some of the sires bred in the experimental herds that possess a superior germ plasm for higher levels of production, will be made available to artificial breeding circuits.

Because of the long-time nature of the breeding experiments, it is difficult to cite special progress in any particular phase of the work in any given year. Each year the animals in those experiments, representing additional generations of experimental breeding, are producing at higher levels and with fewer animals in the mediocre class. For example, 32 females in the Beltsville herd completed records during the past year under the uniform environmental conditions prescribed for the lactation period records that are used for inheritance studies. Of these 32 records, 5 (3 outbreds and 2 linebreds) were over 900 pounds butterfat (mature basis), and only 2 made records that fell below 600 pounds butterfat (mature basis), one of 550 pounds butterfat and one of 527 pounds butterfat. The cows that made the two low records were outbred. Some 24 outbred and inbred cows are now on test for the inheritance measure of their producing capacity and 20 more will be started on test during the coming year.

The Beltsville, Maryland and the Huntley, Montana stations have the greatest number of proved sire generations. The seventh unrelated proved Holstein sire was recently brought to the Beltsville station, and calves are now being born at the Huntley station by the eleventh meritoriously proved sire. A recent analysis of the experiments at the Huntley station shows the following weighted average yields for the foundation cows and for each generation of cows resulting from proved sire matings:

		First	Second	Third	Fourth	Fifth
	: Foundation:	generation:	generation:	generation:	generation:	generation:
	: 73 records:	73 records:	67 records:	54 records:	36 records:	19 records
Milk yield,	:	:	:	:	:	:
pounds	: 11,337	: 18,606	: 17,289	: 16,975	: 17,065	: 17,780
	:	:	:	:	:	:
Butterfat,	:	:	:	:	:	:
percent	: 3.39	: 3.54	: 3.59	: 3.64	: 3.67	: 3.61
	:	:	:	:	:	:
Butterfat,	:	:	:	:	:	:
pounds	: 587	: 658	: 615	: 615	: 622	: 638

These data show that a consistently high level of production has been maintained without the benefit of selection or the culling of poor producing females, by the continued use of meritoriously proved sires. The results in the later generations are probably somewhat better than they appear to be because an epidemic of mastitis depressed production to some extent.

Other field stations have similar breeding experiments under way and the details of the work will be practically as outlined above.

There are now 137 bulls loaned to cooperators from the Beltsville herd. Twenty of these are in artificial breeding associations. A recent summary on the proving of bulls in cooperating herds shows that 78 Holstein bulls sired 1,275 daughters that averaged 464 pounds butterfat (mature equivalent), an average increase of 35 pounds over their dams;

and 70 Jersey bulls sired 970 daughters with an average yield of 436 pounds butterfat (mature equivalent), an average increase of 28 pounds more than their dams.

The loan of bulls to farmers in the vicinity of field stations will continue as rapidly as conditions and the supply of bulls will permit. The number of bulls loaned has been slowed somewhat because of the inability of many cooperators to obtain the services of testers, which is a prerequisite to the loan of bulls, but there are a large number of bulls in the process of being proved by cooperators. After the war, when testing facilities again become normal the number of bulls loaned will no doubt increase. In the meantime, the bulls that have been on loan and the newly loaned ones are adding to the number of generations of progeny sired by sons of good proved sires.

There is an increasing demand for the loan of bulls to artificial breeding circuits. These circuits have bull selection committees working in connection with the State Colleges that go into the subject of the pedigrees of bulls that are most likely to possess an inheritance that will enable them to be good transmitting sires. One of the desirable features of the loan of these bulls to such circuits is the great number of offspring they are likely to sire and the consequent widespread dissemination of the superior germ plasm developed in the experimental breeding herds.

Pasture grasses as sources of nutrients. In 1940 at the Huntley station, alfalfa and Ladino clover were seeded separately in three half-acre irrigated plots with canary grass, orchard grass and meadow foxtail, respectively. The first season the plots were cut and the green material made into silage. The plots with the alfalfa combinations exceeded in yield the plots with the Ladino clover combination by approximately 20 percent. Last season the plots were grazed by milking cows. The computed yield of total digestible nutrients per acre was 5,488 pounds for the alfalfa-grass combination as compared to 4,761 pounds for the Ladino clover-grass combinations, or an increase of 12 percent for the alfalfa-grass mixtures.

At the Lewisburg, Tenn., station a series of 12 pasture plots were seeded to various combinations of grasses and clovers including lespedeza, white clover, hop clover, crimson clover, orchard grass, bluegrass, and Ladino clover. In most cases seeding was done on prepared seed beds but on some plots the seed was sown on the sod. Check plots were retained that received no treatment or seeding other than mowing to control weeds. Seeding crimson clover on bluegrass sod which had been limed and manured increased the grazing by 19.2 percent. Bluegrass sod that was not mowed produced 15 percent less grazing than bluegrass sod that was mowed to control weeds. A mixture of orchard grass and Ladino clover produced the most grazing and supplied 3,139 pounds of total digestible nutrients per acre, which was three times as much as native bluegrass sod.

A 5.5-acre field was set to kudzu plants in the spring of 1940 at the Willard, N. C., station. The plants were set in 5-foot rows after an application of 2 1/2 tons of barn manure per acre. In 1942 five tons per acre of barnyard manure were applied. It was grazed slightly that

year. In 1943 four milking cows grazed this field. Precautions were taken to see that the kudzu was not grazed so close as to affect the stand. It furnished a grazing season of 116 days or 62.6 cow-days per acre. It produced 1,002 pounds of total digestible nutrients per acre, which compared favorably with pearl millet and Korean lespedeza and was more than double that furnished by soybeans.

Ungrazed grass clumps varying in size and number occur in most permanent pastures. The usual practice, when anything at all is done, is to mow these clumps, the idea being that when the new grass comes on it will be grazed. Experiments show that if cows avoid the first growth because of the droppings they will also avoid the second growth. An exploratory experiment was conducted to see if spraying the clumps with molasses would induce cows to graze them. An application of molasses at the rate of 400 pounds per acre resulted in 65 percent or more of the herbage being eaten in 24 to 48 hours. Such a practice on a commercial scale might be practicable if the ungrazed clumps made up a considerable part of the total area and suitable implements for spraying were used.

Crop production at Mandan, North Dakota: At the Mandan, North Dakota, station records have been kept of crop yields for a 16-year period and records of costs of growing the crops have been kept for 7 years. The 16-year average yield for corn silage (flint corn) was 4.3 tons per acre. During the same period, average yields of grain were 23.8 bushels of barley and 31 bushels of oats. These average yields include 3 years when no crops were harvested because of drought. The costs per 100 pounds of total digestible nutrients over the 7-year period 1937 to 1943, inclusive, were 47 cents for corn silage, 65 cents for oats, and 49 cents for barley.

Urea as a substitute for protein supplements. The addition of 10 pounds of urea to the ton of silage slightly impaired palatability and did not improve the preservation of any of the nutrients of corn. Although the urea is quite soluble there was no undue waste in the effluent from the silo even when this effluent amounted to 3 percent of the total weight. A 5-month feeding experiment at Beltsville showed that cows when fed on corn silage made with the addition of 0.5 percent of urea did practically as well as when fed on normal corn silage with urea fed separately. There was no advantage in adding urea to the corn as the silo was being filled. Cows fed on urea declined 13.5 percent in milk in 100 days or only about two-thirds as much as would ordinarily be expected.

Soybean meal can be replaced with an equal weight of low protein feed plus one-seventh as much urea without affecting production materially one way or the other. It appears that as long as high protein feed can be obtained there will be but little demand for urea from the feed manufacturers. The place of greatest usefulness for urea is on those farms where plenty of grain is grown but where there is need for more protein. This need can be supplied with urea more cheaply than with oilseed meal. The cost of the urea is not likely to exceed one cent per cow per day.

Silos and silage. The most favorable stage of growth to ensile oats, from the standpoint of yield and palatability, was found to be at the late milk or soft dough stage although oats at this stage will have less carotene and a little less protein than at an earlier stage. Wilting

was not necessary and preservatives were not used.

The capacity of silos was found to be approximately the same for corn as for hay if the moisture content of the two crops is the same. Greater weights of grass silage are due mainly to the high moisture content of the grass rather than to the kind of crop.

At the Sandhill (South Carolina) station a project has been under way for several years to determine the relative efficiency for milk production and the relative economy of ensiling various forage crops for feed when they are at the stage of maturity to make the best quality of silage, or of grazing these growing crops with milking cows. A number of different crops have been used in this work and it is possible that sufficient data will be secured during the coming year to warrant its analysis and publication.

Value of prairie grasses for pasturage and hay. At the Mandan, North Dakota station, where large amounts of native prairie grasses for pasturage and hay are available, an experiment has been under way that may be concluded this coming year to determine the relative value of prairie grass hay supplemented with additional protein from oil meals, and of alfalfa hay alone for milk production. The results of this experiment may have considerable value in the prairie states. Many other experiments, such as the relative carrying capacities of different combinations of grasses and legumes, the effect on composition and feeding value of herbage topdressed with liquid manure, the periods of grazing and the carrying capacities of different grains and legumes, and the effects of different rates and methods of fertilization are being carried out at different stations.

Physiology of dairy cows in relation to production. In continuing the studies of anatomical structure of the mammary gland tissues of cows with records of performance, statistical analyses have been made to determine the interrelationships between size and capacity of the udder, many different structural characteristics of the udder, and the cow's producing ability. Further studies have been made to determine the effect of infections at different periods of life on the mammary gland tissue of the udder.

Tabulation work has been concluded on data accumulated over a period of years pertaining to the rate of increase in the size of the bovine fetus and in the quantity of fetal membranes and fluids throughout the gestation period. This has an important bearing on problems involving consideration of the size and shape of the body and on the nutrition of cows during pregnancy.

Substantial progress has been made in the statistical analysis of measurements of body form and growth throughout the lifetime of the animal. For many of the body measurements of the individual calf as young as 3 months of age shows the same relation to the breed average as does the corresponding measurement during lactating life. Measurements taken at 6 months of age show even a closer relationship. It is expected that the results will show the extent to which the size and form of the body of the calf are indicative of the same characteristics in

the cow and serve as a guide in predicting body conformation in the cow by examination of the calf.

Valuable additions have been made to the data on the internal anatomy of cows with production records, the significance of degree of mammary gland development in the calf as an indication of producing ability in the cow, the relation between the size of digestive organs and maximum feed capacity, and various other phases of the project.

Further studies will be made to determine the relationship between external form--especially abdominal measurements--size of stomachs and intestines, maximum feed capacity, to milk-producing ability in the cow.

Studies will be continued to determine the significance of variations in degree of mammary gland development in the young calf as a means of providing a reliable method for culling out potentially low producers at an early age.

The study of the relation between measurements of body form and size of internal organs and body cavities, and of the relation of both external form and internal anatomy to producing capacity is a long-time project designed to establish a scientific basis for the selection of dairy cows when production records are lacking. Studies of various udder characteristics in the calf that may be significant in prejudging udder characteristics and the potential producing capacity of the cow will also require a number of years.

Investigations of the nutritional and other physiological factors affecting the usefulness of dairy cattle:

Unidentified nutrients in milk. Research during the past few years has provided convincing evidence that milk contains some growth-promoting substance that has not yet been identified. Since, in planning nutritional programs, a shortage of milk in some form may sometimes make it necessary to rely more on other foods, it is important not only to know the nature of the unidentified substance in milk but also the extent to which it may exist in other foods.

In the studies of this unidentified nutrient (referred to as X) in milk, it has been determined that it is not folic acid, and results have been obtained on (1) its effect on growth on (a) diets containing lactose, and (b) diets containing various levels of protein; (2) its effect on the development and functioning of various bodily organs, particularly the reproductive organs and the kidneys; (3) its relation to the occurrence of any cytopenia or anemia; and (4) its occurrence in various materials.

In experiments with small animals in which the same control animals were fed a diet containing adequate amounts of all known nutrients, and others the same diet supplemented with small amounts of the commercial liver extract that is used in the treatment of pernicious anemia as a source of X, the difference in growth in a period of 4 weeks was about 67 g. in favor of the latter.

In order to determine the relationship of X to growth in rations containing lactose, a basal diet was fed containing 25 percent lactose, which was substituted for an equal amount of dextrin. While lactose depressed growth of animals on diets deficient in X, this did not occur with diets adequately supplemented with X. This result coincides with and explains the results obtained by feeding skim milk powders.

Investigations have disclosed that the addition of a considerable amount of casein in the diet of small animals depressed growth and caused loss of weight and death in some cases. However, when the high casein diet was supplemented with X rather rapid growth was attained. Mixtures of the crystallin-B-vitamins containing thiamin, riboflavin, pyridoxin, pantothenic acid, nicotinic acid, inositol, choline, and para-aminobenzoic acid, did not overcome the depressant effect on growth produced by feeding the larger amounts of casein. X had a remarkable effect, but whether or not optimum growth may be obtained by supplementing the basal diet containing 40 percent casein with X is problematical.

Additional examinations of the body organs of animals were made to determine the effect of X on their development and functioning. The weights of the thymus, testes, epididymis, seminal vesicles, and prostate were greater with males fed the X factor, and the same was true with the ovaries, uterus, and thymus in the females similarly fed. The seminal vesicles, thymus, ovaries, and uterus were also heavier per unit of body weight. On the other hand, in all cases the kidney weights per unit of

body weight are greater in the control animals, and this is very decidedly true with some of the older animals. Further experimentation will be necessary to determine whether this hypertrophy is associated with any definite pathological condition in the kidney.

Corresponding with the increased size--both relative and absolute--of the reproductive organs in the females there is decided evidence of earlier maturation and functioning of these organs.

No. 3 timothy hay poor source of vitamin A, protein, calcium, and carotene. Results of experiments at Beltsville indicate that a ration consisting of grain and U. S. No. 3 timothy hay supplemented with cod-liver oil led to the production of fat of a vitamin A potency equivalent to butter containing about 5,800 and 3,700 I.U. per pound, respectively, for Holstein and Jersey cows, whereas pasture cows produced fat equivalent in potency to butter containing 17,600 and 23,120 I.U. per pound, respectively. While the former figures should not be considered to represent butter encountered under normal market conditions, it would appear that the feeding of U. S. No. 3 timothy hay, even when supplemented with sufficient cod-liver oil to supply the vitamin A necessary for the production of a normal calf, leads to the production of milk that is a poor source of vitamin A. It is obvious that an amount of vitamin A adequate for normal calving and normal health may be inadequate for the production of desirable milk and butter from a market standpoint. Poor grade timothy hay is low in protein containing 2.9 percent of digestible protein as compared with 10.6 percent for alfalfa. It is low in calcium, containing only 0.2 percent to 0.35 percent as compared with 1.4 percent for alfalfa. It is also low in carotene (the precursor of vitamin A), in phosphorus, and apparently may not be a good source of iodine. Such hay has however been useful as a roughage in experimental work in the study of the effect of feeding minimum quantities of various nutrients, such as protein, calcium, and carotene.

Studies were made of the vitamin A potency of the colostrum of certain cows that had been on pasture until calving, and of others that had received a barn ration low in vitamin A. The barn ration consisted of grain and U. S. No. 3 timothy hay, supplemented with enough cod-liver oil (10 or 20 ml, with potency of 2,000 I.U./ml.) to supply the vitamin A to maintain the normal health of the cow and to permit her to have a normal calf. Calves of cows fed in this way may, nevertheless, have very little vitamin A stored in their bodies at birth, and must depend upon their mothers' colostrum for their immediate supply of this nutrient. The colostrum yielded during the first and second day after calving was most potent as a source of vitamin A. This maximum potency varied with different cows from 3.5 to 8.5 times that of the milk subsequently secreted by them. The secretion rapidly declined in potency to practically that of ordinary milk on the sixth day. At comparable times after calving the vitamin A potencies of the colostrums of the cows on pasture were several times those of the cows on the barn ration. The relation varied from day to day from about 2-fold to as much as 12-fold.

Investigations of dairy herd-improvement association practices in relation to efficiency of production:

Interest among dairymen of the country in testing work as conducted in dairy herd-improvement associations is now greater than at any previous time. There is every indication that dairymen generally are more fully cognizant of the value of maintaining food and production records on their dairy cows. During the year feed and production records for more than 515,000 cows were tabulated and analyzed. These compilations and analyses were returned to the States for the use of extension dairymen in their programs of dairy herd-improvement.

The dairy herd-improvement association herds have a higher level of milk and butterfat production than ever before. Last year the average production was 8,323 pounds of milk and 339 pounds of butterfat. More than 100,000 cows in dairy herd-improvement associations produced more than 425 pounds of butterfat. The association herds constitute the principal source of breeding stock for the dairy herds of the Nation. During the year 2,764 sires were proved in dairy herd-improvement association herds. The daughters of these sires had an average butterfat production of 379 pounds. The production level of these daughters when compared with the average of 339 pounds for all association cows and the average of 182 pounds for all dairy cows is indicative of the superiority of breeding stock found in association herds. The high place that the dairy herd-improvement association program holds in the improvement of the dairy cattle of the Nation is further indicated by the fact that the dairy breed associations are cooperating closely with the program to make it as effective as possible. During the fiscal year 1944 plans were completed with the Ayrshire, American Dairy, and Brown Swiss brooders' associations under which all herd test data obtained by these breed associations will be transferred to and included in the dairy herd-improvement association proved-sire program. In 1943 nine hundred twenty-seven of the 1,057 operating associations reported data for use in the Nation-wide proved-sire program. Approximately 65,000 identification and 150,000 production records were reported by the various States and approximately 7,000 production records were reported by the breed associations to be included in the proved-sire program. The genealogical or family tree record being maintained includes more than a million and a half association animals and production records for approximately 3/4 million association cows. Dam and daughter data are being accumulated on approximately 90,000 sires in association herds. The eighth annual list of proved sires contained the summary of proved-sire records of 3,101 sires. This list makes available to dairymen the information obtained in dairy herd-improvement association herds and enables them to select the best breeding stock available to improve the inherent producing capacity of their herds.

Studies will be continued (a) to determine the relative merits of the local dairy herd-improvement associations in which the supervisor does all of the testing and record work on the farm and of the county-wide type of association in which the testing and record work is done in a central testing laboratory; (b) of record-keeping forms and methods now in use

to develop the most efficient and practical type of individual and herd records; (c) to determine if job instruction training methods may be employed to advantage in the training of association testers; and (d) on feed and production data to provide State leaders and dairymen with current information for continued improvement of the efficiency of milk production. Records will continue to be compiled and analyzed in order to determine the breeding value of individual sires and families of animals of different breeds. These data provide the principal source of information for dairymen in the selection of breeding stock in their efforts to improve the inherent producing ability of their herds.

Investigations of milk and milk products:

Dried milk keeping quality improved by low oxygen concentrations.

The deterioration of butter and dried milk is caused largely by oxidation of the fat. The resistance of the fat to oxidation is dependent upon manufacturing processes and the methods of handling and packaging the products. The effect of variations in the methods of processing milk prior to desiccation, the temperatures of drying, as well as methods of packaging in an inert gas will be studied.

Studies of the relationship of oxygen tension (concentration) to the rate of deterioration of butterfat were extended to dried milks. Correlated with these studies was one on the amount and composition of gases held by absorption in dried milks. The rate and extent of release of these gases was determined and the conditions of evacuation established which would give final oxygen concentrations of 1%, 2%, 3%, etc., in the containers. Twelve hundred samples of commercial dried milks were examined to determine their general keeping qualities and to establish methods for testing the keeping qualities of the product.

Glycerol from whey by yeast fermentation. Investigations of the vitamins essential to fermentation of lactose by yeasts have shown that several of the B vitamins are necessary and that at least one of them is destroyed by the bisulfite, which seems necessary if the product of fermentation is to be glycerol. Potassium is a biologically essential metal and a microbiological method has been devised and is being perfected for its determination in fermentation media. This information is already proving of value in speeding up fermentation processes involving yeasts. The results of investigations of the reactions of bisulfite to lactose and related sugars have made possible the development of a method for determining maltose in maltose-glucose mixtures, a method long needed in the sugar industry. Information on the structural features of some of the common sugars has also been obtained.

Resins and lacquers from lactic acid. Several baked coatings based on the resin from lactic acid have been developed for use in metals. These are characterized by their resistance to action of alkali and steam. Air drying coatings have been developed that are suitable in instances in which ease and cheapness of application are more important than resistance to

alkalies and steam. Resinous products suitable for use as binders and laminating agents have also been prepared. A novel procedure has been developed for making lactyl-lactate esters, a little-known series of compounds of considerable promise as plasticizers and resins. One of these in particular, a chloroethylene ester, is highly resistant to heat and alkline agents and has plasticizing properties, indicating broad application in the production of plastics.

Riboflavin (vitamin B₂) from whey. Progress has been made in developing a technique for increasing the quantity of riboflavin in whey by means of a fermentation process. It has been shown that at least one other B vitamin is produced in this fermentation. Adsorbates of riboflavin from fermented whey have been prepared of sufficient potency to be practical for use in fortification of bread to the degree recommended by nutrition experts.

Whey solids used in ice cream. Investigations of the uses of whey solids in ice cream were completed. These investigations developed methods of utilizing a product of high food value that is frequently wasted. The factors affecting sherbet quality were studied and definite progress has been noted.

Bureau methods of manufacture improve quality of Cheddar cheese. In the past, an objection to the pasteurization of milk for cheesemaking was raised on the ground that it resulted in a decrease in the rate of ripening. The results of recent work indicate that pasteurization of high quality milk has no significant effect on the rate of ripening. The rate of proteolysis in the cheese is retarded, however, by pasteurization of milk having a high bacterial content, but when such milk is not pasteurized the cheese made from it is inferior in quality.

Work has been conducted on the development of a laboratory test for biacetyl (a flavor compound) in Cheddar cheese in connection with the use of different auxiliary starters. The test provides an easy and rapid means of measuring the amount of flavor development in cheese.

Intensive work on the improvement of Cheddar cheese quality through the introduction of Bureau methods was conducted in Minnesota, Indiana, Michigan, Ohio, Missouri and Arkansas. The work in Minnesota, Michigan and Indiana has been completed. To date the work has been pursued in a total of approximately 150 factories in which approximately 100,000,000 pounds of cheese is manufactured annually. Data upon the results of work in all factories are not available. However, data from a number of factories in each State in which work was done indicate that the introduction of Bureau methods has raised the production of No. 1 grade cheese in such factories from an average of approximately 35 to over 90 percent. The Cheddar cheese quality improvement program will be continued and extended to additional factories.

New process for dehydrating Cheddar cheese. A process for dehydrating cheese has been completed and is being used commercially. Certain long-time keeping quality tests are being continued.

Utilization of whey proteins in cheese manufacture. Proteins separated by heat from Cheddar cheese whey have, with certain variations in procedure, been adapted to the manufacture of a cottage type cheese. They have also been pressed into forms and cured by means of the mold Penicillium roqueforti in an effort to produce a type of Roquefort cheese as a means of utilizing more efficiently and completely the proteins of whey. A very acceptable cheese of this type has been made. Further improvement in and standardization of the method of manufacture are necessary.

New processing methods for manufacturing evaporated and condensed milk. Two new methods of forewarming milk to give it the heat stability necessary for the manufacture of high solids evaporated milk have been developed. It is expected that these methods will be simpler and more readily adapted to factory practice than the earlier method which involved the use of patented equipment.

Changes which occur in the body of evaporated milk during manufacture and storage have been studied. The optimum storage conditions under which the Army and lend-lease stocks of evaporated milk should be held have been determined. Studies of the requirements for the production and storage of a sterile high solids evaporated milk of good body have been continued with encouraging results.

Preliminary results indicate that sugar can be saved in the manufacture of sweetened condensed milk through the use of high temperature forewarming methods.

Administration and Enforcement of the Process (or Renovated) Butter Act (regulatory):

Considerable progress was made in improving the sanitary conditions of process butter factories. Two factories installed modern butter printing and wrapping machinery and all factories made changes and alterations designed to improve sanitary conditions.

The process butter industry was able to obtain priority rating to purchase several thousand dollars worth of new steel containers, thus facilitating improvements in the sanitary handling and transportation of packing stock butter. An order for more such cans has been placed. A consolidation of facilities for collecting packing stock butter was effected during the year which resulted in material savings in gasoline and mileage. The procurement of packing stock butter was expedited by this consolidation. Greater care was also exercised in the storage and handling of other ingredients used in making process butter.

Regulatory research and investigations frequently contribute information of value to different industries. The extraction of butter oil from butter and re-emulsifying it with milk or milk products is an essential part of the methods involved in the manufacture of process butter. During the year a detailed study of the methods used contributed information of value to the wartime problem of making butter oil and of reconverting butter oil into butter and other dairy products.

Special attention will be given to the character and condition of all ingredients, particularly packing stock butter, intended for use in the manufacture of process butter. The infestation of packing stock butter with the larvae of the skipper fly during the summer months is the most serious problem confronting the process butter industry as well as the most serious problem of regulatory inspection under existing law. To exercise suppression and eradication measures to limit and control this problem will be the primary concern of this project during the coming year. All ingredients intended for use in the manufacture of process butter will continue to be examined under this project this year and suggestions and recommendations made that will facilitate improvement of sanitary conditions of all permitted ingredients of process butter.

The process butter industry has made many changes in manufacturing methods and practices within the past few years. Whether all such changes are advisable from a regulatory viewpoint is frequently debatable. Present shortages of supplies and materials are conducive to manufacturing changes. During the coming year special attention will be given to all such changes and investigations made to determine their effect upon process butter, particularly from a sanitary viewpoint. Such investigations may also reveal improved sanitary procedures which may be recommended to the process butter industry.

(b) Special Research Fund, Department of Agriculture
(Allotment to Bureau of Dairy Industry)

This budget schedule covers obligations under an allotment for special dairy cattle and dairy products research.

(c) Working Fund (Bureau of Dairy Industry)

This budget schedule covers obligations under an advance pursuant to Section 601 of the Economy Act of June 30, 1932, for the development of dairy production and nutrition in other American Republics.

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS
(1944 and 1945 figures include overtime costs)

Item	Obligations: 1944	Estimated obli- gations, 1945	Estimated obli- gations, 1946
<u>Special Research Fund, Depart-</u>			
<u>ment of Agriculture:</u>			
For dairy cattle and dairy			
production research	\$60,438	\$60,761	\$53,656
<u>Working Fund (Bureau of Dairy</u>			
<u>Industry) (Advance from</u>			
<u>Office of Coordinator of Inter-</u>			
<u>American Affairs): For de-</u>			
velopment of dairy produc-			
tion and nutrition program in			
other American Republics	1,970	- -	- -
Total, obligations under supple-			
mental funds	62,408	60,761	53,656

PASSENGER-CARRYING VEHICLES

The Bureau of Dairy Industry does not contemplate any expenditures for the purchase of passenger-carrying vehicles during the fiscal year 1946. It is expected that four vehicles will continue in operation.

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PENALTY MAIL

Section 2, Public Law 364, 78th Congress
(Allotment to Bureau of Dairy Industry)

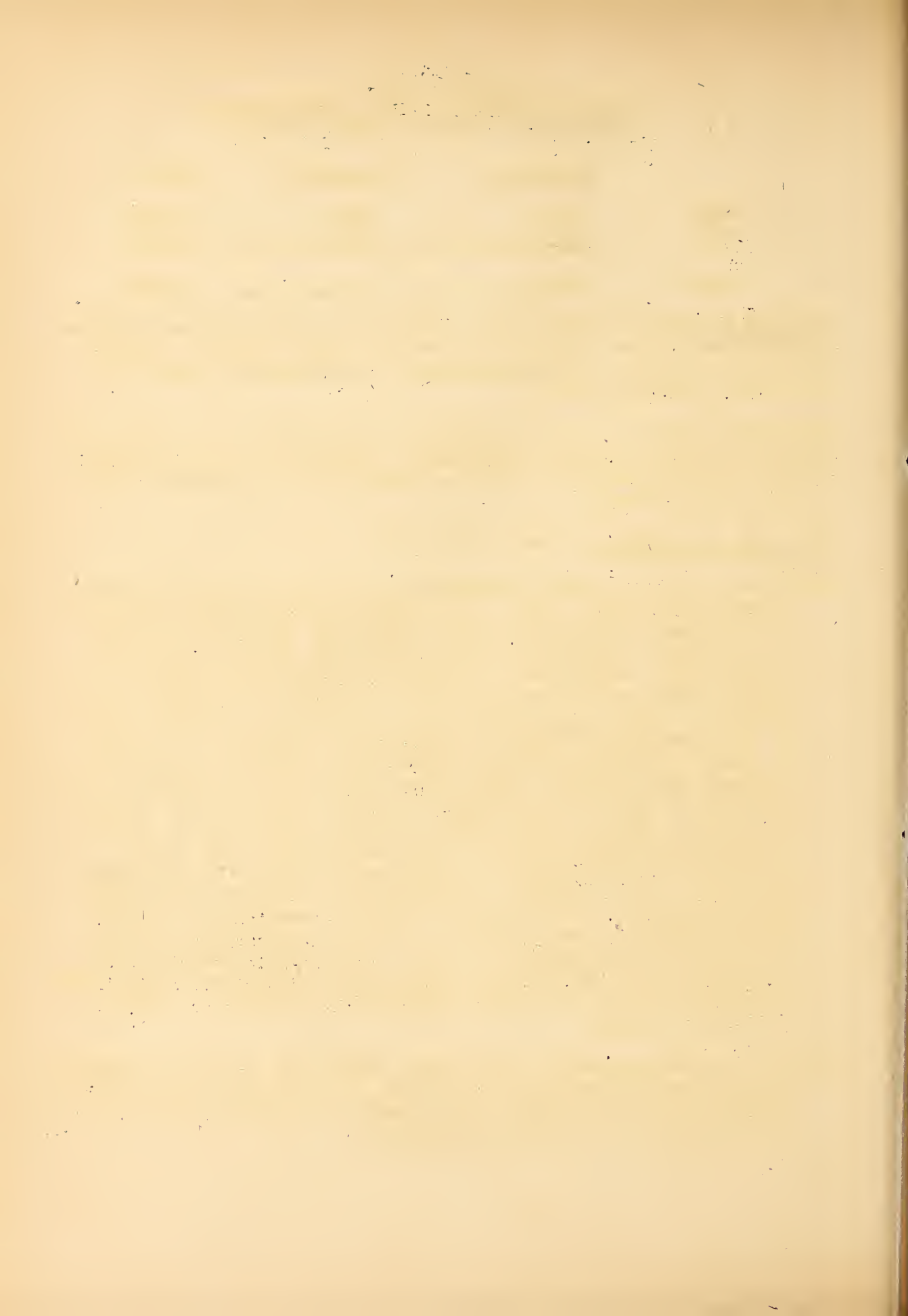
	<u>Category 1</u>	<u>Category 2</u>	<u>Total</u>
1945	\$410	\$692	\$1,102
1946	1,050	692	1,742
Change	+640	- -	+640

Category 1 consists of bulletins, leaflets and other technical publications furnished upon request and in answer to questions and problems raised in connection with dairy industry, and dairy herd improvement association monthly letter.

Category 2 consists of general administrative correspondence between the bureau, its field stations, cooperating agencies, and other government agencies and for mailing the documents involved in the business transactions of the bureau.

The increase of \$640 for 1946 consists of:

- (a) \$370 to permit a wider distribution of the dairy herd improvement association monthly letter. The primary purpose of this letter is to disseminate timely information concerning the Bureau's proved sire project. The work of proving sires and preparing lists of proved sires involves the expenditure of approximately \$88,000 annually. This work is definitely and directly in the interest of dairymen. Unless they receive prompt information concerning sires of the breed in which they are interested the value of the project to dairymen would be materially decreased. These lists provide dairymen with sire data which enable them to select breeding stock designed to improve the producing ability of their herds. The information in these monthly letters should be disseminated to all cooperating dairymen and this can be accomplished only if the letters are sent directly to county agents, dairy herd improvement supervisors (cow testers), and State dairy extension specialists. Unless this increase is allowed, it will be necessary to confine the distribution of these letters to State extension specialists in bulk and reply upon them to make a further distribution within their States, as was done during part of the fiscal year 1945. This procedure, however, has proven ineffective and should be replaced by direct mailing.
- (b) \$270 for dissemination of additional information by means of pamphlets and mimeographed material, on the work of the Bureau of interest to dairymen, milk and dairy products manufacturing plants, State and city milk inspectors, and extension workers.



BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING

The simplification of the appropriation structure for the Agricultural Research Administration proposed in the 1946 estimates involves a consolidation of subappropriation items for the Bureau of Plant Industry, Soils, and Agricultural Engineering, reducing the number of items from 17 to 6. One item, "Plant Industry Experiment Farm," carried under this Bureau head in 1945 is transferred in the estimates to "Salaries and expenses, Office of Administrator, Agricultural Research Administration".

The following table shows a complete distribution of the 1945 subappropriation amounts on the basis of the proposed new subappropriation set-up for 1946:

(Please see table on next page)

Distribution of 1945 Fiscal Year Appropriations under the Consolidations Proposed in the 1945 Budget Estimates

Existing Subappropriations, 1945		Proposed Appropriation Items, 1946					
Title a/	Total amount	Field crops	Fruit, vegetable, and specialty crops	Forest diseases	Soils, fertilizers, and irrigation	Agricultural, turf, engineering, Arboretum	
General administrative expenses	\$225,000:	\$89,142:	\$70,852:	\$10,700:	\$29,413:	\$24,893:	
Agricultural engineering investigations b/	436,639:	-:-	-:-	-:-	-:-	436,639:	
Cereal crops and diseases	650,524:	650,524:	-:-	-:-	-:-	-:-	
Cotton and other fiber crops and diseases	456,702:	456,702:	-:-	-:-	-:-	-:-	
Drug and related plants	70,308:	-:-	70,308:	-:-	-:-	-:-	
Dry-land agriculture	257,563:	11,380:	29,145:	-:-	217,038:	-:-	
Forage crops and diseases	327,837:	327,837:	-:-	-:-	-:-	-:-	
Forest pathology	255,300:	-:-	-:-	255,300:	-:-	-:-	
Fruit and vegetable crops and diseases	1,463,877:	-:-	1,463,877:	-:-	-:-	-:-	
Irrigation agriculture	145,000:	-:-	3,400:	-:-	141,600:	-:-	
National Arboretum	31,500:	-:-	-:-	-:-	-:-	31,500	
Plant exploration, introduction, and surveys	298,913:	162,495:	136,418:	-:-	-:-	-:-	
Soil and fertilizer investigations	346,791:	-:-	-:-	-:-	346,791:	-:-	
Soil survey	162,582:	-:-	-:-	-:-	162,582:	-:-	
Sugar plant investigations	370,000:	370,000:	-:-	-:-	-:-	-:-	
Tobacco investigations	143,520:	143,520:	-:-	-:-	-:-	-:-	
Total	5,642,056:	2,211,600:	1,774,000:	266,000:	897,424:	461,532:	
						31,500	

a/ In addition, \$56,976 under the item "Plant Industry Experiment Farm" was transferred to "Office of Administrator, ARA."

b/ Includes \$83,000 appropriated in First Supplemental Appropriation Act, 1945.

(a) Preamble

CHANGES IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

For [the investigation of fruits, fruit trees, grain, cotton, tobacco, vegetables, grasses, forage, drug, medicinal, poisonous, fiber,] expenses, independently or in cooperation with public or private agencies, including individuals, necessary for investigations, experiments, and demonstrations in connection with the production and improvement of farm crops and other plants and plant industries[, of soils]; soils and soil-plant relationships, and [of] the application of engineering principles to agriculture[, in cooperation with other branches of the Department, the State experiment stations, and practical farmers; for the erection or alteration of necessary farm buildings and buildings at the National Arboretum: Provided, That the cost of erecting any one building, except head houses connecting greenhouses, shall not exceed \$2,500, and the cost of alterations to any one building shall not exceed \$500 or 2 per centum of the cost of the building as certified by the Secretary, whichever is greater, but in no event to exceed \$2,500]; plant diseases, including nematodes, and methods for their prevention and control; plant and plant-disease collections and surveys; the distribution of weeds and means for their control; methods of handling, processing, transportation, and storage of agricultural products; and plants in foreign countries and our possessions for introduction into the United States, including explorations and surveys, and propagation and testing in this country; for the purchase of not to exceed two airplanes; and for [the employment of persons and means] personal services in the city of Washington and elsewhere [required for the investigations, experiments, and demonstrations herein authorized], as follows:

The changes in the language of the preamble are recommended incident to the proposed simplification of appropriation structure. The first change deletes reference to specific crops, since such references are carried in the language of the subappropriation items which follow. New language is inserted to conform to more customary style of appropriation language and to a construction suitable for inclusion of subsequent changes in the paragraph. The language covering cooperation in carrying out the research program is placed nearer the beginning of the preamble, and the present language on cooperation is deleted. Also deleted is language relating to erection or alteration of buildings, since limitations thereon, applicable to the entire Agricultural Research Administration, are proposed in the language for the Office of Administrator.

The proposed change which inserts language relating to research on plant diseases, weeds, nematodes, on handling, processing, transportation and storage of agricultural products, and on plant exploration and introduction is descriptive of work common to more than one of the proposed new appropriation items. In the interest of simplicity, and to avoid repetition under the subappropriation items, it is considered desirable to include the reference thereto in the preamble. No additional authorizations are intended beyond those currently available.

Authority is requested for purchase of not to exceed two airplanes for use in connection with investigations to develop airborne equipment for application of insecticides, fungicides, herbicides, and fertilizers, and to sow seed in farming and forest areas. This authority is requested in order that the Bureau may have authorization to utilize not to exceed two airplanes from a possible surplus of planes no longer serviceable for military needs. Purchase of new aircraft is not contemplated.

(b) General Administrative Expenses

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Field crops", "Fruit, vegetable, and specialty crops", "Forest diseases", "Soils, fertilizers, and irrigation", and "Agricultural engineering", as shown in the table on the second page of the explanatory notes for this bureau. Similar recommendations are made in the estimates with respect to all other bureaus under the Agricultural Research Administration where the general administrative expense item has not previously been consolidated with subject-matter appropriation items. This conforms with action taken by the Committee and the Congress in recent years whereby "General administrative expenses" items of other bureaus of the Department have been consolidated with the related "subject-matter" appropriations.

(c) Field Crops

Appropriation Act, 1945 (none under above title)	\$ - -
Proposed transfers in the estimates from the following	
appropriation items within the Bureau:	
General administrative expenses	+89,142
Cereal crops and diseases	+650,524
Cotton and other fiber crops and diseases	+456,702
Dry-land agriculture	+11,380
Forage crops and diseases	+327,837
Plant exploration, introduction, and surveys	+162,495
Sugar plant investigations	+370,000
Tobacco investigations	+143,520
Total available, 1945	2,211,600
Budget estimate, 1946	1,971,400
Change for 1946:	
Overtime decrease	-275,200
Increase	+35,000
	<u>-240,200</u>

PROJECT STATEMENT

[Note--Amounts in parentheses opposite numerically identified projects are the totals of the alphabetically designated subprojects which immediately follow]

Project	1944	1945 :(estimated):	1946 :(estimated):	Increase or decrease
1. Cereal production, breeding, disease, and quality investigations ..	:(534,192):	:(628,750):	:(628,750):	--
(a) Barley	68,787:	65,530:	65,530:	--
(b) Corn	162,195:	156,320:	156,320:	--
(c) Seed flax	31,805:	32,450:	32,450:	--
(d) Grain sorghum	35,526:	35,310:	35,310:	--
(e) Oats	38,454:	38,410:	38,410:	--
(f) Rice	42,783:	43,390:	43,390:	--
(g) Wheat	213,612:	215,710:	215,710:	--
(h) Weeds	41,030:	41,630:	41,630:	--
2. Cotton production, breeding, disease, and quality investigations ..	389,415:	384,840:	384,840:	--
3. Fiber plants other than cotton	61,721:	61,980:	61,980:	--
4. Forage crop production, breeding, disease, and quality investigations ..	:(305,829):	:(324,770):	:(359,770):	(+35,000)
(a) Alfalfa	60,594:	62,060:	62,060:	--
(b) Clover	25,207:	27,040:	27,040:	--
(c) Soybeans	25,016:	35,190:	70,190:	+35,000(1)
(d) Lespedeza, cowpea, and miscellaneous legumes	34,414:	33,420:	33,420:	--
(e) Hay and pasture grass	153,201:	159,370:	159,370:	--
(f) Turf	7,397:	7,690:	7,690:	--
5. Rubber production, breeding, and disease investigations	29,521:	29,260:	29,260:	--
6. Sugar-plant production, breeding, disease, and quality investigations ..	:(355,662):	:(360,160):	:(360,160):	--
(a) Sugar beets	192,360:	194,200:	194,200:	--
(b) Sugarcane	123,771:	124,250:	124,250:	--
(c) Sugar sorghum	39,531:	41,710:	41,710:	--
7. Tobacco production, breeding, disease, and quality investigations ..	123,923:	146,640:	146,640:	--
Overtime costs	272,645:	275,200:	--:	-275,200
Unobligated balance	30,292:	--:	--:	--
Total available	2,203,200:	2,211,600:	1,971,400:	-240,200

Project	1945	1945 :(estimated):	1946 :(estimated):	Increase or decrease
Transferred to "Salaries and expenses, Office of Information, Department of Agriculture"	+\$900:	- -:	- -:	
Total estimate or appropriation (1944: and 1945 adjusted for comparability)	2,204,100:	2,211,600:	1,971,400:	

INCREASES OR DECREASES

The net decrease of \$240,200 for 1946 consists of the \$275,200 decrease for overtime, and

(1) An increase of \$35,000 to develop control measures for soybean diseases.

Objective: To reduce losses from diseases that are increasing rapidly in prevalence in the major soybean-producing areas, and threatening the production of this vital wartime and peacetime crop.

The Problem and its Significance: The enormous expansion in soybean acreage and production during the past few years has greatly accentuated the disease problems of this crop. The total soybean acreage for seed, forage, and soil improvement purposes in the United States has increased from less than 3,500,000 in 1930 to more than 15,000,000 acres, with a present annual value of approximately \$500,000,000. The soybean crop is providing an important part of the vital wartime supplies of oil and protein.

Numerous diseases of the soybean occur in the United States and production cannot be maintained at the present level unless control measures are developed. In 1944 leaf diseases are estimated to have reduced the average yield of beans by at least one bushel per acre, a total loss of over 10 million bushels. A disease called "bud blight," found in many soybean fields in the Corn Belt in 1944 and reducing production by at least a million bushels, is spreading rapidly. Individual fields were reduced in yield as much as 50 percent. Several other soybean diseases have been severe in some areas and threaten to cause heavy losses as the expanded soybean acreage makes conditions more favorable for the development of disease epidemics.

The production of soybean seed for commercial purposes has become a well-established industry, chiefly in the North Central States, and more than 100 mills are now engaged in the processing of soybeans for oil, meal, flour, flakes, and grits. Other mills are engaged in manufacturing various food products from the beans, flour, grits, and flakes, and these products are being used extensively as a valuable source of protein by our civilian population, our armed forces, and our allies.

The soybean oil is used in shortening, margarine, salad oils, and in the manufacture of enamels, paints, varnishes, rubber substitutes, printing ink, oil cloth, and core binder, while the meal left after the oil is extracted is utilized largely for cattle, hog, and poultry feed, and to some extent for industrial purposes.

It is evident from the varied and important uses of soybean protein and soybean oil in the diet of our civilian population, our armed forces, and our allies that the demand for soybean production will continue into the postwar period. The soybean crop can be produced with tractors and combines, made into nonperishable protein concentrate, and shipped in small stowage space at low transportation costs. Such a product can compete in world markets at a favorable price, thus providing the farmers of the United States with an export market for protein food. This should result in the permanent diversion of some American acreage from surplus crops of the past to a high and stable acreage of soybeans.

The urgency of the soybean disease problem is recognized by both soybean growers and the processing industry. Collectively they urge that disease control methods be developed before some widespread epidemic seriously curtails production required to meet wartime needs. With vegetable oil imports cut off from the Far East, such an occurrence could be a catastrophe. The development of effective controls and of disease-resistant varieties, therefore, should be undertaken without delay.

Plan of Work: Work will be conducted in cooperation with State Experiment Stations and the U. S. Regional Soybean Laboratory. Plant disease specialists will be located at Federal and State experiment stations to work on important soybean disease problems in the Corn Belt and in the Southern States. Field, greenhouse, and laboratory experiments will be conducted to provide the information necessary to devise effective control measures and to develop in cooperation with plant breeders, disease-resistant varieties for release to growers.

CHANGE IN LANGUAGE

The estimates propose the following language for this item:

Field crops: For investigations on the production, improvement, and diseases of alfalfa, barley, clover, corn, cotton, flax, grasses, oats, rice, rubber crops, sorghums, soybeans, sugar beets, sugarcane, tobacco, wheat, and other field crops,
\$1,971,400.

This item represents a consolidation of the appropriation items now carried for "Cereal crops and diseases", "Cotton and other fiber crops and diseases", "Forage crops and diseases", "Sugar-plant investigations", and "Tobacco investigations", together with part of the work now carried under the items for "Dry-land agriculture" and "Plant exploration, introduction, and surveys"; and a part of the item for "General administrative expenses".

The appropriation language recommended above for "Field crops", and the language recommended for the preamble, are intended to provide the same authorizations for the research work involved as were provided by the 1945 Agricultural Appropriation Act.

WORK UNDER THIS APPROPRIATION

Objective: The broad objective of the research program on corn, cotton, wheat, alfalfa, sugar beets, and other field crops, is to advance public and farm welfare, by developing information, methods, and materials to: (1) Increase efficiency and reduce costs of crop production; (2) insure ample and constant supplies of food, and feed crops for the optimum nutrition of our people and their livestock; (3) insure supplies of fibers and other raw materials in the quantities and of the kinds needed for satisfactory industrial uses; and (4) increase farm income to encourage and support a high standard of living. More specific objectives are as follows:

(a) To develop improved field crop varieties, adapted to different regions and soil types, resistant to disease and other hazards, high in yield and quality and superior in handling, nutritional, or technological values.

(b) To develop practical control methods for crop diseases.

(c) To devise cultural practices giving optimum returns in crop yield and quality at a minimum cost.

(d) To devise practical systems of culture, cropping, and chemical treatments for the control of weeds.

The Problem and its Significance: This appropriation provides for improvement, disease control, culture, and quality investigations on the principal farm crops grown by American farmers. The corn, cotton, hay, wheat, oats, tobacco, soybeans, sugar beets, and other crops on which research is conducted had a total farm value in 1942 of more than \$8,600,000,000. These crops provide the principal part of our food, as food grains, sugar, and oils, and indirectly as feed and pasture for livestock; of our supply of fibers, oils, and other raw materials for industrial uses; and include as well the most important soil-improving and soil-conserving crops.

During the war the immense productive capacity of American farms through the application of technological advances has been amply demonstrated. The problem is to maintain these advances and to further increase efficiency and reduce costs. Further progress is completely dependent on research.

Research has shown that improved strains of the different crops can be developed for each area, and that these strains, because of disease resistance or better adaptation to other prevailing hazards, may

greatly reduce fluctuations in yield and quality. Improvements in cropping and cultural methods and seed treatments also reduce hazards. Proper attention to all of these considerations opens the way through research to maintain more certain production of our basic crops.

A continuing research program to improve the efficiency of our field crop production is essential to provide necessary information for re-adjustments which must be made in passing from emergency wartime production to a normal peacetime basis, and to protect the economic position of the American farmer in the immediate postwar period and during the peace to follow. For example, cotton before the war was our most important agricultural export and still produces the major portion of the income for more farm people than any other crop. Unless we produce cotton of better quality than any other country, and are able to sell our cotton at world prices, we cannot recover foreign markets after the war. Results of our fiber quality research have given us a definite advantage in quality, but these gains must be consolidated and work continued, and in some cases expanded, if American cotton is to continue to be the best in the world. With the world price per pound below the domestic price it is evident that increased efficiency at reduced cost is essential. The most logical way to reduce production costs per pound is by increasing acre yield, through research on nutrition, breeding, disease control, and cultural problems. This must be done if American cotton is to survive competition with foreign growths in world markets, and with synthetic fibers at home.

The necessity for a continuing research program also is emphasized by changes that are occurring year in and year out in a large and varied country such as the United States, including the introduction of new crops into regions where they were not previously grown, the introduction of new varieties of crops into old regions, the introduction of new disease-producing organisms from outside sources, and the appearance of new, more virulent strains of old established diseases that arise through hybridization or mutation. These changes present a never-ending series of potential catastrophes to American farmers, and constant vigilance and prompt attack by plant scientists on each problem as it arises contribute greatly to the stability of our agricultural production. Such vigilance and research must be continued if the food and other crop needs of our people are to be adequately supplied, and the American farmer is to compete successfully in world markets.

General Plan: The work consists primarily of field, greenhouse, and laboratory experiments in cooperation with State experiment stations, Federal agencies, farmers, crop-improvement associations, and other similar groups. Cooperative work is in progress with each State, and intensive studies are conducted at central points where special facilities are available for developing information on diseases and their control, resistance to cold and drought, and other factors important in breeding improved varieties.

Results are made available to farmers through the State and Federal extension services, publications, the agricultural press, and correspondence in reply to direct inquiries. During the war emergency, every effort is being made to make available to farmers and agricultural workers helpful information on problems brought about by shortages of labor, fertilizers, seed, metallic fungicides, etc. Technical information and assistance are furnished action agencies for use in developing production goals, fertilizer allotments, and similar programs. Arrangements are made, in cooperation with State and with other Federal agencies, to insure adequate seed supplies of improved varieties, and to increase as rapidly as possible seed of new improved types.

Examples of Progress and Current Program:

Cereal Crops:

New barley varieties: Varietal changes are taking place in America's 15,000,000 acres of barley, increasing supplies of this important feed grain and of the malt necessary for making industrial alcohol from grain. In Wisconsin and other Upper Mississippi Valley States, the stripe-resistant Wisconsin Barbliss is now the standard variety. Trebi, a variety long popular on irrigated lands, is giving way to the new smut-resistant varieties, Compana and Glacier in Montana, and Velvon in Utah. Vaughn, resistant to stripe, scald, and mildew, occupies a considerable acreage in California and Arizona. Peatland and Kindred, resistant to stem rust, are grown in the upper Mississippi Valley. Tregal, a smooth awned variety, should replace the rough-awned feed varieties in North Dakota. In the South, Sunrise, Iredell, Davidson, Randolph, Jackson, Texan, and Tunis, all resistant to one or more diseases, are replacing varieties formerly grown.

Sunrise, the variety most recently released for growing in the South, is awnless. This characteristic should make the variety popular in the region, since southern farmers prefer hooded or awnless types. Sunrise has given superior yield both when grown in the Coastal Plain and in the Piedmont. Although it may prove to be a better grain-producing variety than Davidson, released a few years earlier, it likely is not as widely adapted. Sunrise is resistant to mildew and some forms of smut, and also has resistance to greenbugs.

Additional new sources of disease resistance in barley are being discovered. These will greatly increase the choice of suitable parental material available for use in the breeding program. Recent tests have disclosed the existence of a number of varieties which have resistance to two or more diseases. Special attention is being given to increasing seed of new improved barley varieties that have recently been released or are about to be released to growers.

Hybrid corn makes enormous contribution: The development of hybrid corn for America's 100,000,000-acre corn crop, through cooperative research of the Bureau and State agricultural experiment stations, is one of the most revolutionary agricultural accomplishments of our time. Increased yields from hybrid corn in 1942 and 1943 added in each of these years the equivalent of one-fourth of a normal corn crop in the days before this development. In 1944, hybrid corn was grown on some 57 percent of the Nation's corn acreage, and despite unfavorable early season conditions, 1944 corn production was approximately 3,258,000,000 bushels, our third successive 3-billion bushel crop. Corn hybrids with better smut resistance, with superior resistance to root, stalk, and ear rots, and with resistance to various seedling diseases, and with ability to stand in the field until harvested, all contribute to the Nation's increased production.

Hybrid corn got off to a slower start in the South than in the Corn Belt. As corn hybrids began to make good in the Corn Belt, corn breeders in the South in cooperation with the Bureau turned their attention to the development of hybrids adapted to that territory. These efforts now are bearing fruit and new hybrids bred in the South from adapted southern varieties rapidly are becoming available for commercial planting. Southern hybrids first became available in Tennessee, and in 1944 were grown on about 270,000 acres in that State. The Tennessee hybrids also are well suited to portions of neighboring States. Several new Louisiana hybrids are entering commercial production this year. These hybrids have been exceeding the yields of the best local varieties now available by 25 percent. As a result of this outstanding performance, the demand for seed has far exceeded the supply. Plans have been developed to expand seed production as rapidly as possible. Five promising new double crosses, two white and three yellow, also are coming into commercial production in North Carolina. The white hybrids are suited to the lower coastal plain, two of the yellow hybrids are suited to the Piedmont section, and the third yellow hybrid has made an excellent record in the mountain section. Rapid expansion of the hybrid corn acreage of the South is expected as these and other adapted hybrids get into commercial production. Available records indicate that when adapted hybrids become widely grown in the South they will duplicate the outstanding records made by those of the Corn Belt.

Iowa Hybrid 306, developed in cooperation with the Iowa Agricultural Experiment Station, is very rapidly replacing Iowa Hybrid 939 in Iowa and Nebraska, where 939 has been standard for nearly ten years. Iowa 939 has a tendency to drop its ears before harvest and Iowa 306 is a material improvement in this respect. Only a few years ago Iowa 939 probably was grown on more acres than any other contemporary hybrid. Its gradual replacement by Iowa 306 is an indication of steady improvement in the hybrids available to corn growers. The ability of Iowa Hybrid 306 to retain its ears reduces harvest losses and improves the quality of the harvested crop.

Three groups of single crosses were studied for corn-borer resistance in 1943. Significant differences in borer tolerance were recorded among 45 midseason single crosses. Indiana P8 produced crosses which were outstanding in borer tolerance, and crosses involving K230 and Ohio 61-67 were highly tolerant.

During the past year Bureau personnel assisted in supervising the production of foundation single crosses in Ohio, Indiana, Iowa, Kansas, Missouri, Tennessee, North Carolina, and Louisiana. As a result of this service the production of foundation single crosses was able to function smoothly in all of these States and was greatly expanded in Kansas and Louisiana. The demand for foundation stocks of the Kansas hybrids has far exceeded even the enlarged supply, however, and the program will be further expanded. The enlarged supply of foundation single crosses was utilized during 1944 in the expanded production of double-crossed seed. It will be reflected in the hybrid corn acreage, therefore, in 1945. If the hybrid corn acreage is to be maintained or increased, adequate seed of the foundation single crosses must be produced well in advance of the time they are needed.

Improved seed flax varieties increased to meet new demands: War demands for increased supplies of linseed oil have given increased importance to the breeding of flax of higher oil content and improved quality of oil. An extensive flax-breeding program conducted in cooperation with the Minnesota, North Dakota, and Montana Agricultural Experiment Stations has resulted in the development of several new varieties of flax, which not only yield more than varieties previously grown, but have a higher oil content and better drying quality of oil.

Three new flax varieties were released to growers of certified seed in 1943. Crystal, a selection developed at University Farm, St. Paul, Minnesota, in addition to being highly resistant to rust, yields a high percentage of oil of excellent drying quality. The variety appears to be well adapted to Minnesota conditions. Renew is an early-maturing, rust-resistant variety well adapted to the Northern Great Plains. Arrow, a selection from a cross between Bison and Renew, is similar to Bison in most characters except that it is resistant to rust. All of the new varieties are resistant to wilt. Seed will be available for general planting in 1945. In 1944, about 1,000 acres of Crystal were sown in Minnesota, 1,200 acres of Renew were sown in North Dakota, and 400 acres of Arrow were sown in Montana, for increase of seed.

Special attention is being given to the increase and distribution of seed of these new disease-resistant flax varieties. Work also is being emphasized on the breeding of cold-tolerant varieties for south Texas and of Anthracnose-resistant varieties for California.

Improved oat varieties pay off at harvest: One of the phenomenal developments in American agriculture since 1941 has been the increase of the rust- and smut-resistant oat varieties, Boone, Cedar, Control, Marion, Tama, Vicland, and Vikota, in the Corn Belt and adjacent areas. Whereas these oats were grown on less than 100,000 acres in 1941 it is estimated that 15,000,000 acres were devoted to them in 1944. This increase has resulted because these varieties outyielded those formerly grown by from 6 or 7 bushels per acre in any year, and in the rust years, they frequently have yielded twice as much. Considerable acreage was grown as far east as New York and Pennsylvania in 1944.

The farm yields of oats in the North Central States in 1943 reflect the influence of the new varieties in that area. Average yields for each of 5 States in the area for the 10-year period (1932-1941) before distribution of these varieties has been almost the same; Iowa, 31.8 bushels; Illinois, 32.8 bushels; Minnesota 31.7 bushels; Wisconsin, 31.3 bushels; and Michigan, 31.0 bushels. Comparatively favorable conditions for oats prevailed throughout the region in 1943, yet in Iowa and Wisconsin, States where the new oats, Boone, Control, Marion, Tama, and Vicland, occupied most of the acreage, yields averaged 37.5 and 39.0 bushels per acre, respectively, compared with 33.0 bushels in Minnesota, 33.0 bushels in Illinois, and only 21.0 bushels in Michigan, where the old varieties still were principally grown.

Progress is being made in developing rust- and smut-resistant oats for those areas not previously supplied. In the Southwest where spring sown red oats are grown, selections from crosses between Fulton or similar strains with those of the Boone type give promise. Two of these, Ventura and Osage appear especially promising in the Southwest and may have value in the southern part of the Corn Belt as well as elsewhere. Both are being increased in Kansas. They are short, early, yellow-kerneled oats which produce excellent yields and which have resistance to most races of the rusts and smuts. In Kansas, yields of these varieties have exceeded Fulton, a widely grown variety by some 10 to 12 percent. In Iowa, they have exceeded Boone, Tama, and Marion for 2 years by about 20 percent each year.

Special attention is being given to the increase and distribution of seed supplies of the new disease-resistant varieties already released or about to be released to growers in the different areas of the country. In the spring oat areas, increased attention also will be given to producing and testing strains resistant to stem rust races 8 and 10 which are becoming increasingly prevalent in the North Central States and which may become a real threat to the oat crop in that area. In the winter oat area special attention also will be given to producing more hardy strains having resistance to both crown and stem rust and to smut and suitable both for grain production and pasture.

New rice varieties have superior quality and high yield: Pressing demands for more rice to supply Allied Nations cut off from normal supply sources has resulted in an increased acreage in the United States and elsewhere in the Western Hemisphere. In 1943, rice was sown on about 1,500,000

acres in this country. This was nearly 52 percent more than the average acreage for the period 1932-41. Production was 70 million bushels, or 48 percent above the 1932-41 average. This record crop consisted largely of new improved varieties developed in cooperation with the Arkansas, California, Louisiana, and Texas Stations. Both improved varieties and improved cultural practices developed in the cooperative program have helped materially to maintain yields in spite of the expanded acreage which was made possible by shorter rotations and inclusion of areas less favorable to rice production. In 1933, only 19 percent of the rice acreage in the United States was sown to varieties distributed from the cooperative program whereas in 1943 new varieties from the program were grown on 52 percent of the total acreage. One reason for the increasing popularity of the new varieties is superior quality with consequent higher farm price than for those being replaced. Another reason is reduced loss from disease.

Texas Patna, a new early-maturing rice, was distributed in 1943 and in 1944 is being grown on about 20,000 acres in Texas, and Louisiana. It is similar in grain type, yield, and quality to Rexoro, but matures about 10 days earlier, and is equally disease-resistant. Its earliness, as compared to Rexoro, provides a needed measure of safety in harvesting operations.

Special attention is being given to the increase, distribution, and maintenance of pure seed supplies of new improved and commercial varieties; to determining the adaptation of new disease-resistant varieties; to the development of new disease-resistant strains of superior quality for each of the rice-producing areas of the country; and to studies on the relative effect of fertilizer when used with and without straw.

Better grain sorghum and broomcorn varieties: Cody, a new variety of waxy sorghum increased from nursery rows in 1941 to 32,000 acres in 1944, is now ready to supply most of the starch needed to replace tapioca for puddings, pie filler, and other food uses. Tapioca starch, formerly imported from the Dutch East Indies, is no longer available here for use as food. Starch from Cody sorghum has been found to be equal or superior to that from tapioca for either food products or for making adhesives. Cody was found to be superior to other waxy sorghums in several important characteristics. The grain is white and free from water-soluble pigments difficult to remove from starch whereas other commercial waxy varieties have colored or spotted seed coats. Cody grain is larger and softer than other waxy varieties and easier to mill. The stalks of Cody also are shorter than those of other waxy varieties, which permits the crop to be harvested more readily with a combine.

Experiments on root-rot and stalk-rot diseases of sorghum indicate that most of these diseases will be difficult to control. Losses from pythium root-rot, however, have been practically eliminated by the development and distribution of resistant varieties. Four other serious stalk-rot diseases caused by species of Sclerotium, Colletotrichum, Spicaria, and Rhizoctonia have recently been discovered as damaging. Charcoal rot, caused by the organism Sclerotium bataticola, is widely prevalent and no variety as yet

has been found to be highly resistant to the disease. The milos and milo hybrids, as a group, are highly susceptible to charcoal rot. One new combine type hybrid strain has some resistance. Investigations indicate that the charcoal-rot organism usually enters the roots and crowns of sorghum plants through wounds, and that wounds caused by soil-inhabiting insects, particularly the sugarcane weevil, seem to offer an entrance for the disease organism.

Fulltip, a new variety of dwarf broomcorn, is unique in the large number of fine fibers or seed branches which develop near the tip of the brush, a characteristic which greatly enhances sweeping quality in a broom. The brush is of medium length and smooth except near the tip where the numerous seed branches are concentrated. Another important character of Fulltip broomcorn is the long handle which bears the brush well out of the boot so that very little staining occurs as is common in all other varieties of dwarf broomcorn. This greater freedom from staining enables farmers to grow the dwarf Fulltip in humid sections where heretofore only standard (tall) varieties have been grown. Fulltip, first distributed in 1942, is rapidly becoming popular in western and central Oklahoma.

New wheat varieties reduce losses: The distribution of Pawnee hard red winter wheat in southeastern Nebraska and eastern Kansas is expected to reduce losses from hessian fly, which in 1943 amounted to an estimated 25,000,000 bushels of wheat in Kansas alone. Pawnee is not resistant to all races of hessian fly but will greatly reduce damage. It also is resistant to leaf and stem rust, loose smut, bunt, and lodging, and is highly satisfactory in other respects. Other new varieties more completely resistant to hessian fly as well as to the more prevalent diseases are being produced. Satisfactory fly-resistant varieties, by permitting the sowing of winter wheat at the most favorable time, also will do a great deal to reduce losses from winter-killing.

Wichita, a new very early-maturing variety of hard red winter wheat has been approved for distribution in southwestern Kansas, western Oklahoma, and northwestern Texas as soon as supplies of seed can be increased. It will be an important addition to the list of varieties available to farmers in those areas who like to put a part of their acreage in an early maturing variety in order to distribute harvest labor. Early maturing varieties may escape damage from rusts, hot winds, drought, or hail, when others are badly damaged. Early Blackhull is the only very early maturing variety now grown in the southern Great Plains. Wichita, about as early as Early Blackhull, is of much better bread-making quality, and produces heavier grain and higher yields.

About 8,000 bushels of Cache and 400 of Wasatch, both hard red winter wheats resistant to dwarf bunt, were produced in the Gallatin and Flat-head valleys of Montana from seed secured originally from Utah. This seed was made available for planting in the fall of 1943. These varieties are highly resistant to the dwarf bunt which in recent years has threatened wheat growing in these valleys, and though not as winter hardy nor as satisfactory for quality as is desired, they nevertheless are considered a satisfactory stopgap until better varieties can be produced.

About 16,500 bushels of the new leaf and stem rust-resistant spring wheat varieties, Mida and Newthatch, were seeded in the spring of 1944. These eventually should replace much of the Thatcher, Rival, and Pilot now grown in western Minnesota and the eastern Dakotas. About 500 bushels of the new stem and leaf rust-resistant variety, Henry, were planted in Wisconsin in 1944. It should replace most or all of the Thatcher and Sturgeon now grown in that State.

Special effort has been given to assuring adequate supplies of high-quality seed of the new hard winter wheat varieties Comanche, Pawnee, and Wichita; of the spring wheat varieties Mida, Newthatch, and Henry; of the new durum varieties Stewart and Carleton; and of Big Club 43, in order that farmers could take advantage of the superior qualities of these varieties as rapidly as possible. Additional information is being secured regarding the disease resistance, winter hardiness, yield and quality of the promising new varieties Westar and Orfed, keeping in mind their possible release and distribution in 1945 or 1946. Special attention also is being directed towards finding new sources of resistance to dwarf bunt and to the new races of stem rust in order to provide parental material for making suitable crosses for obtaining varieties which will be protected against these diseases.

Weed control methods proving out: The Bureau's weed research, less than 10 years old, is paying important dividends. New control methods developed in the cooperative program are being rapidly adopted on farms throughout much of the Great Plains, in the Pacific Northwest, and in the Intermountain States. Increased yields of needed food crops and greatly reduced labor costs are the result. In Kansas, a control program using methods based upon research work of the Bureau in cooperation with the State Experiment Station has eradicated bindweed on more than 50,000 acres of infested land, including more than 30,000 small patches that in a few years would otherwise have spread to a greatly increased infestation. It is estimated that the bindweed will be brought under complete control in the State within 10 years. Similarly, in Nebraska, 48 weed-eradication districts comprising an area of approximately 6,200,000 acres are now in operation.

Control methods to fit various situations have been worked out. These have been developed so as to fit extra work or treatments into existing cropping practices with as little change as possible while still getting satisfactory weed control. All of the new methods save from one-fourth to one-half of the labor formerly thought necessary. These practices are based on two seemingly insignificant but actually important discoveries; (1) that when perennial weeds are cut off they do not begin to replenish the food stored in their roots until they have grown above ground for some time, usually about two weeks, and (2) that European bindweed and some other weeds are very sensitive to shade and cannot grow well under a smother crop. These facts suggested that to control such weeds one should cultivate every 2 weeks during the growing season or keep them completely covered with a smother crop. Also, it has been found that a combination of cultivation with a following smother crop is just as effective in the long run as cultivation alone. This stretches

out the period required for eradication but requires no additional cultivations, greatly reduces the erosion hazard, and makes it possible for a farmer to grow good crops while the weeds are being eradicated. Many farmers have found they can grow just as much wheat on bindweed-infested land as on non-infested land if recommended methods are followed.

It has been possible to work out systems of land management and cropping for most sections of the country where bindweed is a serious pest. Cultivation every 2 weeks or thereabouts applies everywhere, but the kind and way to use smother crops depends on the section of the country. In the more humid and warmer portions of the Great Plains, soybeans are most generally satisfactory. Farther west, thick-sown sorghums, Sudan grass, alfalfa, winter rye, or even winter barley where winters are not too severe, give better results. Strangely enough, cultivated row crops such as corn, potatoes, and sorghums are completely ineffective, since the cultivation ordinarily given them tends to encourage the perennial weeds rather than to subdue them.

Because of the wartime demand for sodium chlorate for other than herbicide uses, substitute herbicides have been investigated. The most promising is borax, which, though not entirely satisfactory on agricultural land, seems worthy of consideration on nonagricultural land such as railroad rights of way, waste places, etc. About 5 pounds of borax is required to equal in effectiveness 1 pound of sodium chlorate. The effectiveness of borax seems more dependent on soil type than that of sodium chlorate, but it can be applied most any time of the year, whereas fall is the most effective time to apply sodium chlorate. Borax is not recommended for cultivated fields because of a too long continued deleterious effect on all plant growth.

The relation of soil reaction and soil texture to toxicity and persistence of various herbicides, especially sodium chlorate, ammonium thiocyanate, and borax, is being given special attention. It is planned to extend methods of control recently developed and used successfully for European bindweed to Johnson grass, Bermuda grass, dogbane, leafy spurge and other perennial, noxious weeds. Special attention also is being given to determining to what extent the methods that have proved so successful may be applied to intermountain irrigated areas and also to dry areas, especially in the Dakotas.

Cotton Investigations:

Cotton research is centered on increasing the production of varieties that will produce the kind and quality of fiber needed in making more than 11,000 different articles for war and civilian use; on increasing the supply of cotton seed for food, feed, and oil, and of linters for smokeless powder and other war uses; and on increasing the efficiency of production so as to insure profitable farm operations.

Breeding cotton with increased strength: Results from the cooperative Federal-State cotton research program have revealed that many of our widely grown varieties were not satisfactory as to fiber strength and spinning performance. Rapid progress is being made in developing varieties with increased strength through the x-ray, breeding, fiber, and spinning researches of the Bureau conducted in cooperation with the State experiment stations and private breeders.

In California, where the only variety that is grown originated on the Bureau's Shafter Cotton Field Station, the strain of Shafter-Acala in production several years ago was found to produce a relatively weak fiber. Intensive breeding work has improved the strength, and the new strain is now in production on the entire cotton acreage of the San Joaquin Valley.

In Arizona, the productive Pima variety of American-Egyptian cotton, bred some years ago by this Bureau, was not accepted by spinners as being entirely the equal of imported Egyptian. Intensive fiber and spinning studies revealed that the reason for this was the relatively weak fiber of the variety. The Pima-Sakel cross (S X P) produced at the Sacaton Field Station is much superior to Pima in strength and has entirely taken the place of the latter in American-Egyptian producing areas.

In New Mexico the highly productive variety College Acala, widely grown four or five years ago, was found to have poor fiber structure and less strength than was required. The new Acala 1517, bred at the New Mexico Station, is stronger than any other cotton of its length and is now in general production in the irrigated sections of New Mexico and West Texas.

In Georgia, the new variety, Empire, developed in the cooperative program at Experiment, Georgia, is definitely better than the Stoneville variety from which it was selected, and was placed in one-variety production in 1944. In the Mississippi Valley and the Southeast, Deltapine 14 and Coker 100, bred by private breeders, have been improved in strength through utilizing the results of our research. All of these varieties that have been greatly improved in strength are now being used in rapidly expanding acreage devoted to standardized production in one-variety communities throughout the Cotton Belt. Other improved strains are constantly being developed and when found superior

in both quality and productiveness will be released for production in one-variety communities. These improvements will help American cotton to meet competition with synthetic fibers and with foreign cotton.

Cotton improvement in standardized one-variety communities: Reports on cotton improvement in standardized one-variety communities indicate that wartime demands for long-staple cotton have resulted in shifts in variety acreage from medium to longer staples in some areas, and that demands for food and feed crops, and acute farm labor shortages in many districts have brought about some substitution of other crops for cotton.

Interest in the one-variety plan of cotton production continues to grow, and many manufacturers have become variety conscious in their purchases of cotton for specific mill uses. At their request, detailed lists of the locations, production in bales, and variety of seed planted are being furnished to cotton manufacturers in the Southeastern States each year.

With the facilities now available for determining the spinning quality of new varieties and strains from small samples of fiber, special attention is being given by breeders to qualities which meet the rigid military requirements for strength, in addition to high yields and other agronomic improvements of value to farmer producers. Studies of the uniformity and quality of the staple being produced in the one-variety communities are under way. The information being obtained promises to become of great value to growers and manufacturers in achieving standardized southwide production of varieties of cotton with the best qualities of staple for war and post-war needs.

The one-variety programs in 1943 were operating in 2,544 communities in 569 of the approximately 775 cotton-producing counties with a membership of 305,801 participating members and a planted area of nearly 9,000,000 acres. A conservative estimate of the extra cash return to farmers in the one-variety communities, based upon the final reports for 1943, is nearly \$7.50 an acre from extra yields and premiums, or a total of about \$66,000,000. Approximately 230,000 additional tons of cotton seed for military and essential civilian uses also resulted from increased yields of cotton in these communities.

X-ray studies reveal new properties of cotton structure: Preliminary studies have shown that the strength of cotton fibers can be increased by stretching when wet, thus aligning crystalline cellulose more nearly parallel with the fiber axis. It has been demonstrated that undried cotton fibers are plastic, and even previously dried fibers can be rendered somewhat plastic in water at 58 to 60° C, or in a 7 or 8% solution of sodium hydroxide. The implication of this discovery is that commercial methods may be developed whereby previously dried fibers may be swollen and then stretched, resulting in a great increase in the tensile strength. Increased tensile strength does not necessarily mean increased resistance to fatigue or wearing quality. Types of cell wall structure important for certain uses may not be as good as entirely different structures for other uses. These findings are of especial

importance in determining the best utilization of certain varieties, as for tire cord or other specific needs, dependent on whether initial strength or resistance to wear is the primary concern.

New technique aids in measuring resistance to important cotton disease: Angular leaf spot, or black arm disease, is frequently severe enough in the Southwest seriously to reduce yield, especially in New Mexico and Texas, and to a lesser degree in some of the mid-south regions. Seed treatment is of some aid, but has not eliminated the hazard. It has long been recognized that there are varietal differences in resistance. Breeding for resistance, however, has been exceedingly difficult because natural epidemics were of haphazard occurrence, and uniform artificially-induced epidemics were very difficult to obtain. During the past year a satisfactory and apparently dependable technique was devised for testing varietal resistance in the seedling stage. These tests further indicated several sources of parental material that might be employed in breeding for resistance.

Preventing deterioration of military equipment in the tropics: Greatly increased interest in rot-proofing fabrics used in military equipment has resulted in numerous requests for service from branches of the armed forces. Much progress has been made in developing and helping to standardize rapid and reproducible methods for evaluating rot- and mildew-proofing treatments. It has been shown that fabric-deteriorating fungi differ greatly in their tolerance to copper, mercury, and other fungicides, and that for critical evaluation of treatments, more than one type of organism should be used. Through the cooperation of many agencies, certain leaching and biological testing techniques have been studied over a wide range of conditions, and suggested improvements in methods are finding ready acceptance in the procurement of treated fabrics and other military equipment. The evaluation of new mildew or rot preventives has established the superiority of some types of fabric fungicides.

Crop sequence and fertilizers influence growth and composition of winter cover crops: Crop rotation and fertilizer experiments show that the composition and growth of winter legume cover crops are influenced by the kind of crop grown and by the kind of fertilizer used the preceding summer. Better stands and growth of winter legumes planted in cotton, corn, and peanut rotations resulted from the use of non-acid-forming fertilizer on the summer crops than from acid-forming fertilizer. The nitrogen content of winter legumes following peanuts is higher than that of legumes following cotton or corn. This indicates that cotton can advantageously follow peanuts and a winter legume in rotations.

Investigations of Fiber Plants Other than Cotton:

Western Hemisphere abaca fiber: The only present source of supply of abaca (Manila hemp) fiber for naval and marine cordage is from Central America. The five commercial abaca projects that have been established in four countries of Central America have furnished since

Pearl Harbor more than 10,000,000 pounds of this critical raw material, and production is now increasing every month. These projects are the direct result of investigational work conducted by the Department, and cooperative research having for its purpose an improvement in quality and a reduction in cost of this fiber is being continued.

Sansevieria and yucca possible hard fiber substitutes: Imported hard fibers, such as abaca, sisal, henequen, and istle, furnish the raw material for cables, rope, binder twine, and hard fiber twines. The critical shortage of these fibers has necessitated a search for acceptable substitutes that might be produced in this country. In the Southwestern States there are large areas of different species of wild yuccas, all of which contain a hard fiber. In Florida there are limited areas of sansevieria, which also contains a hard fiber. In order to determine the practicability of utilizing these plants for fiber, field surveys have been made of the principal yucca areas in the Southwest, and detailed information has been obtained regarding the distribution and stands of these plants. Experimental plantings of sansevieria have been made in Florida, and methods of cleaning and processing this fiber have been investigated. Although neither yucca nor sansevieria fiber have yet been produced in commercial quantities, detailed information regarding the possibilities of these two plants as domestic sources of fiber is being made available through these studies so that they can be used if necessary.

Hemp research supported production program: Experiments to determine whether hemp could be grown further west in the United States in order to be less competitive with food crops, proved negative. The hemp grown in the western region of the Corn Belt suffered severely from insufficient moisture for proper retting, although moisture was adequate to permit satisfactory growth. It appears extremely doubtful from results in the 1943 season and from observations of scattered experiments conducted in former years, that dew retting is feasible in areas west of the Missouri River. Results of the Bureau's research influenced recommendations on seed treatments, fertilizer treatments, straw and fiber grades, and rapid machine methods for determining moisture content of straw, in connection with the war hemp crops of 1943 and 1944.

Forage Crops:

Buffalo and Nemastan added to the growing list of new, disease-resistant alfalfas: In 1944, about 5,000 pounds of seed was produced of Buffalo, a wilt-resistant strain of alfalfa developed in cooperation with the Kansas Agricultural Experiment Station and adapted to approximately the same area as Kansas Common. Where bacterial wilt was a factor in the third year of a test at the Iowa Agricultural Experiment Station, the two highest-yielding strains, Buffalo and Ranger, produced 69 percent more forage than Grimm and Kansas Common. Ranger is a wilt-resistant variety introduced previously. In a seed productivity test in Utah, Ranger and Buffalo ranked first and second in a comparison with twenty-three other strains and varieties.

The stem nematode has made alfalfa production in some areas of Nevada, Utah, California, and adjacent States almost impossible. To combat this condition a new strain called Nemastan, was developed. Approximately 100 pounds of seed was produced in 1944 for further testing and seed increase. Nemastan is a selection from a group of alfalfas collected in Turkistan that proved to be resistant to nematodes, as well as to bacterial wilt. Food production in many of the irrigated valleys of these States will profit by the use of this new strain, because alfalfa hay is the mainstay of livestock production in many of these areas.

Hybrid alfalfa: A new development promises greater progress in alfalfa improvement and production than has hitherto been possible. Recent studies have indicated that hybrid alfalfa exhibits a superiority over commercial varieties comparable to that shown by hybrid corn over open-pollinated varieties. A method has been developed by which hybrid alfalfa is produced by natural crosses between especially selected, self-sterile plants, vegetatively propagated. Double crosses may be made by planting seed of two single crosses in alternate rows in a seed-producing field. In cooperative work with the Nebraska Agricultural Experiment Station, single crosses were significantly higher in forage production than the best commercial varieties. In addition to resistance to bacterial wilt, some of the single crosses were relatively resistant to alfalfa yellowing caused by the potato leafhopper. Some of the leafhopper-resistant hybrids had a carotene (Pro-vitamin A) content twice as high as that of standard commercial varieties grown under similar conditions.

Seed of new mildew-resistant red clover being increased: A new synthetic red clover variety highly resistant to the powdery mildew disease has been developed in cooperation with the Wisconsin Agricultural Experiment Station. Seed is being increased to provide adequate quantities for more extensive testing before release for farm use. Preliminary results have indicated that it is more productive than other red clover strains in Wisconsin. In addition, the quality of the hay is superior to other red clover, since mildew causes a dustiness of the hay.

Rose clover, a new clover for the Southeastern States: Rose clover, *Trifolium hirtum*, a new species introduced from Asia Minor in 1936, gives promise of being adapted in the Southeastern States. This new plant is a vigorous-growing, hard-seeded, winter-annual species having large, rose-colored flower heads. It is a heavy seed producer and has volunteered for several years at several places in the South. The seed of Rose clover is being increased for extensive trial and utilization studies before being released for farm use.

Seed of new Lincoln Soybean variety being increased for commercial production: The yellow-seeded soybean variety, Lincoln, produced in cooperation with the Illinois Agricultural Experiment Station and other States in the North Central Region and the Special Research Fund Regional Soybean Laboratory, has been released for commercial use in the soybean belt. In extensive testing at many locations over several years, it has yielded five bushels per acre more than the average of

Illini and Dunfield, the most commonly grown varieties, and contains about 0.7 percent more oil. An intensive seed increase program is under way and from the 291 bushels of Lincoln seed harvested in the fall of 1942, there was produced 13,345 bushels in 1943. In 1944 approximately 450,000 bushels of certified Lincoln seed was produced. This is sufficient seed to plant 500,000 acres in 1945. The Lincoln Variety is a selection from a cross between Mandarin and Manchu that combines desirable qualities such as high yield, high oil content, good seed quality, and good lodging resistance.

Old and new soybean diseases prevalent in 1944: In 1944 the bacterial leaf diseases were prevalent and destructive in soybean fields throughout the major producing areas, and are estimated to have reduced the yield of beans by at least one bushel per acre, making a total loss in production of over 10,000,000 bushels.

In the Corn Belt in 1944, the newly recognized virus disease tentatively called "bud blight" was present in many soybean fields and in some fields approximately one-half the pods were lost due to virus infection. This disease is estimated to have reduced production by at least a million bushels. The newly recognized bacterial disease, tentatively called "wildfire" and thought to be caused by the same bacterium that causes wildfire in tobacco, occurred in Iowa, Illinois, Mississippi, Arkansas, and Louisiana in 1944. Its general distribution in seed increase fields of the new Lincoln variety in Iowa suggests the possibility of this disease appearing in epidemic form when greatly expanded acreages of this superior new oil variety are planted in the Corn Belt in 1945 and 1946. Phyllosticta leafspot was severe in some soybean fields in the Middle Atlantic States in 1943 and appears to be increasing in prevalence in the United States.

Throughout the South in 1944, sclerotial blight, charcoal root rot, root knot, and similar root diseases were important factors in reducing soybean yields. Anthracnose and pod blight also destroyed many pods thus further reducing seed yields. The above examples are of conditions that will continue year after year until research provides control measures for the diseases that are beginning to take heavy toll. Expanded soybean acreage and the intensification upon fewer varieties make conditions more and more favorable for the development of disease epidemics.

Improved annual lespedeza made available: The very extensive acreage occupied by lespedeza, about 40,000,000 acres, has made it desirable to emphasize the development of improved strains. A new variety known as Climax was made available in 1943. This has given larger yields of hay than standard varieties and has a late season of maturity which extends the grazing season two weeks when it is used in pastures. This, and other improved strains, will help insure economical and increased production.

Improved soil-building practices demonstrated: Cooperative work with the State stations has demonstrated that by using crotalaria and lespedeza in a rotation in which these legumes are volunteered in a grain crop, a continuous plant cover can be maintained to reduce soil

erosion while the legume crop increases the soil fertility and crop yields. The same result can be accomplished by the use of winter legumes in rotation with a summer crop in places where a satisfactory winter legume is available. The recent determination that lupines are superior for this purpose in parts of the South has led to their extensive use in the past year, and the superior value of other winter legumes for various areas has been demonstrated. These practices have resulted in increased and more economical cash crop production and are the basis for preserving soil and soil fertility.

Seed production of cover crops in the Southeastern United States: Most cover crop seed is produced outside the area where it is used for soil improvement and erosion control, and to get an adequate amount for such areas, and in time for seasonal planting has been a difficult problem. To improve this situation, efforts have been made to get legume crops that will produce seed in areas where they are used mostly for soil improvement. It has been demonstrated that in the Southeastern United States where such crops are most needed, a seed crop of lupines and monantha vetch can be grown and harvested successfully and that spotted burclover and wild winter peas produce abundant seed that will volunteer a good cover for a period of years. Big-flower vetch and narrow-leaf vetch give cheap and sure winter cover and can be made to serve in reducing erosion and greatly increasing crop yields.

Lincoln Bromegrass, a new strain for the Central Corn Belt and Northeastern United States: Bromegrass is one of the most promising grasses for hay or rotation pastures in the Corn Belt and Northeastern States. It is one of the best grasses to grow in combination with alfalfa or other rapid-growing legumes. At Lincoln, Nebraska, from extensive tests of over 35 different sources of bromegrass seed, it was found that seed originating from old established fields in the central latitudes were superior in performance to those coming from farther north. Lincoln bromegrass represents a blend of these central adapted strains and has a marked degree of early seedling vigor, along with a high yield of forage and seed. At the present time it represents one of the most desirable types of bromegrass for hay or rotation pastures in the central latitudes. In 1943, approximately 87,500 pounds of certified seed was produced in Nebraska, and in 1944 the production was increased to approximately 225,000 pounds or almost trebled. Much of this seed is moving into adjoining Corn Belt States.

Blind-seed disease of Perennial Ryegrass now present in the Pacific Northwest: A fungus disease that reduces the germinating capacity of perennial ryegrass seed has been prevalent in New Zealand since 1923 and has been designated by the common name of blind-seed. Its presence in this country was recognized for the first time in 1943, when approximately one-fourth the perennial ryegrass seed fields in Oregon failed to meet certification requirements because of low germination. Losses to growers have been estimated to approximate \$100,000 for the season. Similar losses were caused by this disease in 1944. Italian or common ryegrass is generally much less susceptible to attack than is the perennial species. Research is being initiated on the life history and host range of the casual fungus, Phiallea temulenta, in the Pacific Northwest to provide a basis for the development of control measures.

Sagebrush control increases grass and beef production in the Southern Great Plains: Millions of acres of range land in the West are heavily infested with sagebrush and other shrubs which seriously compete with adapted grasses and reduce livestock production. A surprisingly high degree of improvement in grass and beef production has been obtained in cooperative experiments at Woodward, Oklahoma, in recent years, by mowing sagebrush and other competitive plants. The combined results of field and laboratory studies show that mowing once each year for two successive years, sometime between May 15 and July 15, but preferably in June, has reduced the cover of sagebrush over 90 percent and skunk brush 70 percent. This practice also makes the remaining brush plants more palatable as winter browse, controls many weeds, and doubles the cover of grass on the land. In addition, the mowed pastures produced greater gains in livestock. The two-year averages show that mowing increased the carrying capacity 85 percent or 91 steers per section, increased the gains per head 55 pounds or approximately 18 percent, and more than doubled the beef production per acre.

Grasses for turf in the South: Japanese and Manila lawn grasses (*Zoysia* spp.) are two of the most promising durable turfs for intensive use in the southern half of the United States. They have two serious disadvantages, however, namely, slow growth and poor seed production. These two characters have prevented them from being used extensively in the airport grassing programs. Bahia grass, another newcomer to this country, has many of the *Zoysia* characters for producing a dense tough turf but grows more rapidly and is an abundant seed producer in the Gulf States. Seed stocks of two strains, Pensacola and Paraguay, are now being increased for use on airports and for pastures.

Rubber Production, Breeding, and Disease Investigations:

Work accomplished under this project has formed the basis for continued advice to the Forest Service and other government agencies in programs to develop new sources of crude rubber.

In addition to furnishing pertinent information, laboratory tests have been made of hundreds of samples of plants, rubbers, and various gums to determine the practicability of utilizing each as a possible source of rubber.

In field tests of goldenrod made by the Forest Service under the Emergency Rubber Project, difficulty was encountered in obtaining efficient functioning of machines developed for "deleafing" the plants and separating the rubber-containing leaves from the non-rubber-bearing stems and flower heads. A major portion of this difficulty was attributed to the heavily-branched type of plant grown under wide spacing. It was recognized that this might be overcome in part by cultural practices, particularly by close spacing. Definite progress also was made in the selection of new types of plants. Over 200 selections were made to develop new strains with less tendency to branch and improved ability to produce and retain heavy crops of leaves under close spacing.

Tests have been made of special coagulants for Hevea latex and other types of latex, and advice as to their effectiveness furnished to the Rubber Development Corporation.

Basic studies have been made of the qualities of *Cryptostegia* latex from different sources, and new information has been gained as to non-rubber materials associated with rubber in *Cryptostegia* latex. Some of these materials bear an inverse relationship to rubber in the latex and may be intermediate products in the natural formation of rubber.

Since in the two species of *Cryptostegia* there is a wide variation in the relative amount of rubber, resins, and insoluble materials, it is expected that, by a study of rubber from interspecific crosses, a basic knowledge of rubber formation and rubber quality can be obtained and that then these same principles may be used in studying the latex of Hevea brasiliensis and in developing new superior strains.

A choice collection of outstanding Hevea breeding and commercial clones is being established on the Bureau's station at Coconut Grove, Florida. Even though outside the areas where commercial cultivation of Hevea might be expected, there is a long flowering and seed-producing season for Hevea in Florida and this collection is an important nucleus for breeding and other scientific research. Latex from these trees has been supplied to well-equipped laboratories of public and private agencies in the United States where basic investigations of rubber in latex can be conducted more advantageously than anywhere else in the world. In many areas of Latin America where Hevea trees are being cultivated, it is difficult to bring many of the disease-susceptible, high-yielding strains from the East to flowering and fruiting because of the prevalence of the South American leaf blight. This collection, however, is the most valuable present stock of germ plasm for high yield. In Florida, where the leaf blight does not occur, the outstanding high-yielding clones are being grafted on large seedling trees to obtain early flowering of these clones. These trees are being intermixed with other trees top-budded with disease-resistant strains selected in Latin America. The requisites for natural and artificial intercrossing between the high-yielding and disease-resistant strains are being built up in the expectation that the seeds obtained will largely represent crosses, and that there will develop from this research new strains having both disease resistance and high yield that will be of great value to the rubber plantation industry in Latin America.

Sugar Crops:

Progress in fight against curly top of sugar beets: Curly-top-resistant varieties of sugar beet developed under this appropriation have changed the situation in the West from one in which wholesale abandonment of the sugar-beet crop and closing of factories were common to the present assured position of satisfactory beet yields in spite of this destructive virus disease. Curly top still causes serious crop losses, but western growers now plant the sugar beet crop confident that failure from the disease will not occur. U. S. 22, leading variety in 1943 and

1944, will be largely replaced in 1945 with Improved U. S. 22, still more curly-top-resistant. U. S. 15 is only moderately curly-top-resistant, but has low tendency to bolt. It is used for fall plantings in the Imperial Valley and for winter plantings in southern and central California. Breeding work continues, and additional very promising varieties are under test looking toward future introduction.

New leaf-spot-resistant variety makes good: U. S. 215 X 216, released in 1942, has now become the leading variety grown in Michigan, Ohio, Indiana, Illinois, and Wisconsin sugar-beet districts in which leaf spot, a fungus disease, causes serious losses. The variety is not immune from leaf spot, but because of its resistance, it has been able to maintain good root yields and high quality even under epidemic outbreaks of the disease. U. S. 215 X 216, in 3 years of comparative test, produced 6.4 percent more sugar per acre than the earlier introduction, U. S. 200 X 215, and is at least 10 percent superior to European types formerly grown. Such production gains, obtained by breeding an adapted and resistant variety for the farmer, represent highly important, measurable contributions to the agricultural wealth of the nation.

Sugar beet seed enterprise implements breeding research: In 1943, 15,625,800 pounds of sugar beet seed were harvested from 9,926 acres, a record achievement under wartime conditions. 1944 production will almost equal these figures. Not only have planting requirements of our farmers been met, but stricken European areas may also be supplied from such surpluses as are accumulated. Approximately 40 percent of the production comprises U. S. curly-top-resistant varieties stemming from research under the appropriation, and 10 percent is U. S. 215 X 216, a leaf-spot-resistant variety, to supply the more eastern beet-growing districts. All told, varieties produced by the cooperative work of the Bureau constitute annually from 50 to 60 percent of the total production. The beet-seed enterprise is a development of the last decade as a result of cooperative investigations of the Bureau. American production of seed freed our industry from the necessity of importing seed, largely from Germany, to plant our beet fields. Even more significant for the future is the close integration that exists between the enterprise and Bureau breeding research, since new and improved varieties as bred are promptly increased in quantity so that farmers may have them for use without delay.

Sheared seed quality stressed for 1944: In 1944, nearly three-fourths of the total sugar beet acreage in the United States was grown from sheared seed. Introduced in 1943 as a wartime measure to save labor, the new method gave satisfactory results on the whole. As an average, fields planted with sheared seed required about 25 percent less hand labor to block and thin the scant stand, consisting prevalingly of single plants, than was required for the thick stands in fields planted with whole seed at the usual heavy rate. The tendency of farmers to overplant sheared seed prevented full achievement of possible savings. However, some fields, even those in which seedling diseases were not a factor, had thin stands because too high a percentage of the sheared seed pieces gave rise to plants that failed to get above ground. Intensive studies of the seed after milling revealed that often the seed coat around the germ itself was mutilated in the process of

splitting or "segmenting" the whole seed ball. Germination was found to be abnormal from such injured seed pieces, and when planted at usual depth, the seedlings did not emerge. The beet-sugar industry immediately took cognizance of this finding and has sought to give better control in the job of milling the seed balls. Gravity separations of the sheared seed to retain the heaviest and least injured fraction have been instituted. As a result of this increased attention to seed quality, the sheared seed supplied to farmers in 1944 was far superior to that planted in 1943. Correspondingly improved stands have resulted. Indications are that in 1945 sheared seed will be used to even a greater extent by farmers.

Rodent damage to reseeded rangelands affects curly top control: Sugar beet growers have a stake in range rehabilitation since weedy rangelands tributary to irrigated districts are breeding grounds for the beet leafhopper, the insect that carries the curly-top-virus from weeds of the range to sugar beets grown in the irrigated valleys. Experimental plantings of crested wheat grass, now in large-scale use to reseed weedy ranges, failed when protected only against grazing by livestock, but were successful when protected against rabbits and small vermin as well as against livestock. Action programs involving annually re-seeding over 100,000 acres in Idaho and Utah with crested wheat and other grasses are underway to restore weedy rangelands--now low producers of forage. Success of reseedings may be jeopardized by rodent depredations. Where surveys reveal abnormally high populations of rodents, control measures against these vermin are indicated.

Improved sugarcane varieties: Two new and improved sugarcane varieties, C. P. 33/310 and C. P. 33/425 were released in the fall of 1943, marking another forward step in fitting sugarcane varieties to specific needs of the industry. The new varieties are high-yielding and are resistant to sugarcane mosaic. They are "early" canes showing a high sugar percentage relatively early in the harvest season. Both have the highly valuable characteristic of producing erect, straight stalks adapted to machine harvest. Sugarcane grown for sugar or sirup in Louisiana and for sirup in the other Southern States consists almost exclusively of disease-tolerant varieties bred and developed cooperatively by the Bureau or of varieties imported by the Bureau and found by its cooperative tests to be adapted under soil and other conditions prevailing in certain districts.

Progress in sugarcane disease control: The extensive increase of acreage in Louisiana planted with C. P. 34/120 will bring about further reduction of losses caused by sugarcane mosaic. This new variety is being widely used to replace Co. 281, a variety highly susceptible to mosaic. Because of mosaic injury, Co. 281 has produced relatively low yields but its culture persisted because of the superior keeping quality of its stalks when windrowed. Since a portion of the cane must be windrowed in late season when freezing temperatures occur, plantations had continued with Co. 281 in spite of its susceptibility to mosaic. The variety C. P. 34/120 approaches Co. 281 in resistance to deterioration when windrowed and is mosaic resistant, making possible

the retirement of the old variety. Chlorotic streak, now an established disease in certain districts in Louisiana, showed significantly less spread in the crop on well-drained soils than in those where soils were poorly drained. Thus a supplementary means for checking the spread of this disease is available by drainage control, until varieties resistant to the disease can be developed.

Flaming may meet weed menace: Alligator weed and Johnson grass, aggressive perennial weeds now reaching alarming proportions in Louisiana cane fields, may be conquered by a new weapon for weed control, the flame thrower. Preliminary experiments indicate that singeing with the intense heat from a properly devised torch is an effective and relatively inexpensive means for controlling Alligator weed and Johnson grass on fallow land that is later to be planted with sugarcane. Acute shortages of farm labor have made impossible hand hoeing of middles to hold these weeds in check. In some areas the weeds have taken over, infestation being so extensive as to preclude growing sugarcane on lands otherwise suitable. The excellent results from repeated flamings as a clean-up measure on infested land before the crop is planted, and the results from carefully applied singeing of weeds along the rows of the growing crop offer distinct promise, being effective and saving labor.

New sorgo breeding material from tropical Africa: Representative types of lush-growing sorgos of tropical Africa were obtained early in 1944 for breeding a true sugar sorgo for the United States. These collections are the result of a scientific mission by a member of the Bureau's staff to primitive Ethiopia, made possible through cooperation with the South Coast Corporation and the American Sugar Cane League. Journeys of 500 or more miles were made in several directions from Addis Ababa into the region believed to be the center of origin of sorgo. The manifold types of the region as grown in native gardens were thoroughly sampled and seed of 79 varieties brought back to this country, the Ethiopian government cooperating. This assemblage of a wide array of sorgo species and varieties from the tropical home of sorgo has as its purpose the complete examination of the practical sugar-producing possibilities of the crop, drawing upon all available plant material. Up to the present the sorgos in commercial culture in the United States have traced back to subtropical or temperate-zone types, and although highly valuable as a source of sirup, they have not shown decided promise for practical sugar manufacture. Many sirup sorgos have juice of satisfactory sugar content but these have produced a relatively low yield of stalks and have not come up to required standards in acre yield of sugar. The newly acquired group of tropical varieties includes robust, tall-growing forms, and these may supply the breeder the qualities needed for combination with the better of the sirup sorgos to produce a true sugar sorgo. An intensive breeding and testing program is underway to utilize this new material and other new varieties, seed of which recently has been obtained from India and from African sources other than Ethiopia.

The varieties collected in Ethiopia were immediately planted at the Plant Industry Station, Beltsville, Md., and at Meridian, Mississippi, Canal Point, Florida, and Summit, Canal Zone, both to determine the effect of different conditions on growth and seed production and as a precaution against these tropical varieties failing to produce seed under light and temperature conditions at some of the locations. Results of tests at Summit, Canal Zone, and at Palmira, Colombia, the latter being conducted by the Estacion Agricola Experimental, indicate that it will be possible to cross tropical and domestic varieties by controlling time of planting so as to secure simultaneous flowering.

Tobacco investigations:

Correct fertilization of plant beds increases supply of early, vigorous plants: It is generally recognized that a generous supply of available nitrogen is an important factor in the production of early, vigorous tobacco seedlings. For many years it has been believed that the nitrate form of nitrogen such as supplied by nitrate of soda should be a chief component of plant bed fertilizer but recent comprehensive tests throughout the Coastal Plain Area have shown that of all nitrogen sources tried, nitrate of soda was least effective. Ammonia nitrogen, urea, and standard organics such as tankage, used singly or in combination, all increased the average output of seedlings suitable for transplanting by 50 to 100 percent as compared with nitrate of soda and in some seasons the increases were much greater. Nitrate of soda is dissolved by rain water and on sandy soils may leach below the feeding area of the seedling roots. Nitrate of soda is suitable for top dressing plant beds but is seldom effective when applied prior to seeding, which is the chief method of fertilization of the plant bed.

Control of bacterial wilt (Granville wilt) by soil treatment: Experiments completed in 1943 have proven that the wilt disease of tobacco can be controlled effectively in the field by applying about 500 pounds of nitrogen per acre in the form of urea, ammonium carbonate, or ammonium sulphate. Of the three, urea proved the most practical to use. In replicated plots, urea at rates of 250, 500, and 1,000 pounds per acre was followed by 63, 36, and 13 percent of wilt in the succeeding tobacco crops. When tobacco was grown immediately after the urea treatment, it was commercially worthless because of excessive nitrogen. When corn was grown the first year after urea treatment and tobacco the second year, wilt was effectively controlled and the tobacco crop was of high quality. The urea soil treatment also controlled wilt effectively on Irish potatoes, eggplant, and tomatoes.

Reducing damage to tobacco caused by meadow nematodes: Studies over a period of years show that damage to tobacco from meadow nematodes is becoming increasingly serious, particularly in the South Carolina area. In 1943 root collections were made from 60 fields in this region on which the growth of the tobacco was poor. Microscopic examination of these collections disclosed that in most of the fields meadow nematodes were a chief cause of the damage. This survey further indicated that an important factor in the increased losses from meadow nematode was late transplanting due to blue mold. In 1943 transplanting in the South

Carolina area was delayed three weeks by blue mold. Young tobacco plants, not well established with the advent of hot weather, are very susceptible to damage from meadow nematode attack. Two practical means of largely meeting this problem are immediately available. First, the new varieties 400, 401 and White Mammoth have moderate nematode resistance, while the commonly grown older varieties are highly susceptible. Second, effective control measure for blue mold are available and their widespread use would largely eliminate the need for late transplanting.

Control of tobacco root knot through the addition of organic matter to the soil: Root knot is a serious problem to growers of flue-cured tobacco throughout the entire Coastal Plain areas of North Carolina, South Carolina, and Georgia. In an experiment conducted at Tifton, Georgia, on land heavily infested with both root knot and meadow nematodes, certain plots received peanut hay at the rate of 4 tons per acre and other plots were untreated. All were planted to tobacco each year. In 1941, the first year of the experiment, there was a slight reduction in the amount of disease in the peanut-hay plots. In 1942 and 1943, the second and third years, nematode damage was practically eliminated from the peanut-hay plots, while the tobacco grown in the check plots continued to be severely diseased. Average yields of cured leaf from the peanut-hay plots were 1,233 and 1,141 pounds per acre in 1942 and 1943. The corresponding yields from the check plots were 416 and 466 pounds per acre. Similar results have been secured in North Carolina by winter cover cropping with vetch, but in this experiment it was not until the third year that marked reduction in nematode damage was secured. In each experiment the effects from organic matter were cumulative, and non-leguminous residues had little disease control value.

Improvements in flue curing reduce fuel costs and conserve labor:

Under emergency conditions wood as fuel for flue curing has been difficult to obtain and quite expensive when available. It has been demonstrated that coal is a dependable and economical fuel for curing when a stoker with automatic temperature control is installed. With this equipment an even heat can be maintained and the process becomes semi-automatic in operation. This results in a marked saving in the skilled labor that is required in controlling the process day and night with hand firing and use of wood as fuel. A simple device which has been used for preheating the air entering the barn also assures better distribution of temperature and reduces the danger of damage from sponging and curing out with green color. The stoker has been extensively used this past season throughout the flue cured tobacco area.

Problems in the improvement of burley tobacco production: With funds provided in the Appropriation Act for the fiscal year 1945 a cooperative burley tobacco production improvement project is being organized at Waynesville, in the burley area of western North Carolina, the purpose being to develop suitable disease-resistant burley varieties and fertilization, cultural, and curing practices for improving the yield of the cigarette grades of leaf now in strong demand. Preliminary work has shown that much of the crop as now grown contains a high nicotine content and is not of the best quality in other respects. Black root rot,

to which the standard burley varieties are highly susceptible, is an important factor in reducing the yields of high quality leaf and unfortunately the disease is favored by current cropping and fertilization practices that otherwise might promote improved leaf quality.

(d) Fruit, Vegetable, and Specialty Crops

Appropriation Act, 1945 (none under above title) - -

Proposed transfers in the estimates from the following appropriation items within the Bureau:

General administrative expenses	+\$70,852
Drug and related plants	+70,308
Dry-land agriculture	+29,145
Fruit and vegetable crops and diseases	+1,463,877
Irrigation agriculture	+3,400
Plant exploration, introduction, and surveys	+136,418
Total available, 1945	<u>1,774,000</u>
Budget estimate, 1946	<u>1,562,000</u>
Change for 1946:	
Overtime decrease	-237,000
Increase	<u>+25,000</u>
	<u>-212,000</u>

PROJECT STATEMENT

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
1. Deciduous fruit investigations	\$303,226	\$305,520	\$314,520	+\$9,000 (1)
2. Citrus, avocado, and other subtropical fruit investigations	113,942	113,340	113,340	- -
3. Nut investigations	220,711	231,580	231,580	- -
4. Vegetable investigations	350,196	361,340	368,340	+6,500 (1)
5. Potato investigations	97,324	105,180	108,180	+3,000 (1)
6. Investigations of plants: for landscaping and ornamental purposes and farm windbreaks	73,970	75,280	75,280	- -
7. Greenhouse experiments	64,012	70,660	70,660	- -
8. Methods of handling, transportation, and storage, and market diseases of fruits and vegetables, investigations of	189,802	201,880	208,380	+6,500 (1)
9. Drug, oil, insecticide, tannin, flavoring, and related plant investigations	59,200	59,950	59,950	- -
10. Hop production, breeding, disease, and quality investigations	11,600	11,770	11,770	- -
11. Overtime costs	221,560	237,000	- -	-237,000
Unobligated balance	20,707	- -	- -	- -
Total available	<u>1,726,250</u>	<u>1,774,000</u>	<u>1,562,000</u>	<u>-212,000</u>
Transferred to "Salaries and expenses, Office of Information, Department of Agriculture"	+800	- -	- -	
Total estimate or appropriation (1944 and 1945 adjusted for comparability)	<u>1,727,050</u>	<u>1,774,000</u>	<u>1,562,000</u>	

INCREASES OR DECREASES

The net decrease of \$212,000 for 1946 consists of the \$237,000 decrease for overtime and

- (1) An increase of \$25,000 to investigate effects of DDT insecticide on plant growth, its compatibility with fungicides, and its removal as a spray residue. The increase is estimated by projects as shown in the project statement on the preceding page.

Objective: To determine how the use of DDT as an insecticide may affect growth and development of horticultural plants, how it may be used effectively in combination with fungicides, and how it can be removed as a spray residue from products that are to be eaten.

The Problem and its Significance: Phenomenal successes of DDT as a control for certain insects suggest its widespread use as an insecticide for crop plants and ornamentals. Many practical problems must be solved, such as possible effects of the substance upon normal plant growth and development in the field and greenhouse, on fruit setting and seed production, on quality of crop; whether it is compatible with the standard fungicides used in controlling plant diseases; whether there is an accumulative toxic effect through the soil; and how it can be removed from products that are to be eaten (it is described as a nerve paralyzer when absorbed in appreciable quantities).

Because of DDT's unusual promise as an insecticide, and the prospective available supplies after the war, it is important that plant applications and limitations to its use be understood as thoroughly and as promptly as possible. Millions of pounds are already being sought by fruit growers as a control for codling moth, but its real safety or hazard to plant life and to the consumer of apples is unknown. If it proves safe to plant and human life (on edible products) the demand for it will be truly tremendous.

Plan of Work: Experiments will be conducted at headquarters of the Bureau and in the commercial fruit, vegetable, and ornamental-producing districts of the country, in cooperation with the Bureau of Entomology and Plant Quarantine and other research agencies and with growers. Attention will be devoted to effects of spraying and dusting with DDT upon plant behavior, upon disease development, yield, and quality of produce obtained. Field and packing-house studies will be made on the problem of spray (or dust) residue removal and how it is affected by presence of various fungicides or by other insecticides. Effects on marketability and keeping quality (washed and unwashed, treated and non-treated) of produce will be determined. Controlled studies in field and greenhouse will be made to determine possible cumulative effects of the material on plants, on the soil, and on its resistance to weathering.

The studies to be undertaken are of a precise character, requiring a high degree of scientific ability and practical skill. The estimate contemplates that many of the facilities needed can be made available in connection with other investigations in progress. The work will be done at locations where the Bureau has work in progress and highly trained and experienced leaders available for guidance, and will be coordinated with other investigations on fruit, vegetable, and ornamental crops.

CHANGE IN LANGUAGE

The estimates propose the following language for this item:

Fruit, vegetable, and specialty crops: For investigations on the production, improvement, and diseases of fruit, vegetable, nut, ornamental, drug, condiment, oil, insecticide, and related crops and plants, \$1,562,000.

This item represents a consolidation of the appropriations now carried for "Fruit and vegetable crops and diseases" and "Drug and related plants", together with part of the work now performed under the appropriations for "Dry-land agriculture", "Irrigation agriculture", and "Plant exploration, introduction, and surveys"; and a part of the item for "General administrative expenses". The proposed new language, and the language recommended for the preamble, are intended to provide the same authorizations for the research work involved as were provided by the 1945 Agricultural Appropriation Act.

WORK UNDER THIS APPROPRIATION

Objective: The broad objective of the research program on fruit, vegetable, nut, ornamental, drug and other specialty crops is to advance public and farm welfare by developing information, methods, and materials to: (1) increase efficiency and reduce costs of production; (2) insure ample and constant supplies of those crops essential to optimum nutrition of our people; and (3) increase farm income to encourage and support a high standard of living. More specific objectives are as follows:

(a) To develop and make available as rapidly as possible varieties resistant to diseases and adverse climatic conditions, and of superior quality.

(b) To develop more efficient production practices, including fertilization, cultivation, pruning, spraying, and harvesting, to obtain maximum production with minimum use of labor and strategic materials.

(c) To develop and disseminate information on control of diseases causing serious losses, including new fungicide materials for combating them.

(d) To devise methods of packing, shipping, and storing to reduce losses and economize in use of packaging materials and transportation equipment.

(e) To determine regions with suitable soil and climatic conditions for production of drug, condiment, insecticide, tannin, and other specialty crops, and the best varieties and methods of production for such crops.

The Problem and its Significance: These crops include the great health protectors in our diet as well as highly important staple food sources. Their importance in our economy is indicated by the following figures for cash farm income and usage on farms in 1942 for major groupings:

Fruits	\$830,507,000
Truck crops (commercial only)	898,818,000
Potatoes	335,114,000
Sweetpotatoes	58,913,000
Peanuts	84,983,000
Tree nuts	40,835,000

Any substantial reduction in the quantity or quality of these crops as a result of disease epidemics, faulty handling, unfavorable climatic conditions or other causes would mean serious losses, not only to farmers producing them, but also to the health and economic welfare of the whole people. Continuous research to develop improved varieties, and production, handling, and storage methods, is of essential importance to farm and public welfare. Only by a continuing research program can advances already made be maintained and further progress achieved.

The large number of men rejected by Selective Service on physical grounds traceable to malnutrition is clear evidence that the nutrition of our people has been inadequate. In turn the greatly increased demands for food under the high income status and controlled prices of the war period, demonstrate that our population will consume a more adequate diet if made available to them at prices they can afford. Food crops higher in nutritive value and lower in cost, the result of crop improvement and more efficient methods of production, should contribute greatly to improving our general nutritional level by placing nutritious food within the reach of all our people.

Wartime needs for maximum production of all fruit and vegetable crops, under shortages of labor and materials, have made the results of our research program on problems of disease control, seed supply and treatment, variety adaptation, fertilizer requirements, and related production practices of primary importance. Information and materials developed through research are of similar importance to the peacetime welfare of growers and consumers.

General Plan: The work consists primarily of field, laboratory, and greenhouse experiments in cooperation with State agricultural experiment stations, other Federal agencies, and growers. Work is located in 32 states, with intensive studies at central points where special facilities are available for developing information on diseases and their control, resistance to cold and drought, and other factors important in breeding improved varieties.

Results are made available to farmers through the State and Federal extension services, the agricultural press, publications, and correspondence in reply to direct inquiries. During the war emergency, every effort is being made to make available to farmers and agricultural workers helpful information on problems brought about by shortages of labor, fertilizers, seed, metallic fungicides, etc. Technical information and assistance are furnished action agencies for use in developing production goals, fertilizer allotments, and similar programs. Arrangements are made, in cooperation with State and other Federal agencies, to insure adequate supplies of seed or propagating stock of improved varieties, and to increase as rapidly as possible such materials for new improved types.

Examples of Progress and Current Program:

Deciduous Fruit Investigations:

New peach varieties: An early-ripening, yellow-fleshed, semi-cling, high-quality peach, Dixigem, has been developed and introduced for growing in Georgia and other southern districts to replace the white-fleshed, cling, low-quality varieties now used for early shipments. It also ranks high as a free-stone canning variety. In California, a new clingstone selection developed in our breeding program and named Cortez has been found to be very productive and has been introduced as an excellent mid-season canning variety.

At the Plant Industry Station, Beltsville, Maryland, evaluation tests are being conducted on approximately 11,000 hybrid peach seedlings that bore fruit for the first time in 1944.

Pear and cranberry diseases controlled by an organic fungicide: In tests of a wide range of fungicide materials in the Hood River Valley for the control of pear scab without production of excessive russetting, the new organic fungicide Fermate has been the most satisfactory of any commercially available, and growers are using it as extensively as available supplies permit. In New Jersey tests, where field rot of fruit is one of the principal factors limiting cranberry production, vines sprayed with Fermate produced at the rate of 52 barrels per acre, whereas bordeaux-sprayed vines produced only 18 barrels. Further tests of Fermate and other new organic fungicides are in progress, with promising results on certain apple and peach diseases.

Improved methods of flooding cranberry bogs give increased yields:

Two new methods of winter flooding have been developed to avoid vine injury due to depletion of oxygen under the ice. One method is to flood slowly, allowing the vines to become completely enveloped in the thick ice; the other is to flood quickly, and then, when ice is formed above the vines, drain the water from under the ice. One or the other of these methods has now been adopted by practically all cranberry growers in Wisconsin, and the consequent reduction in oxygen-deficiency injury has been a factor in the recent increase in per acre production of cranberries in that State.

New methods of blossom-thinning save labor: In the Shenandoah-Cumberland area, a blossom-thinning spray for apples of a 0.2 percent concentration of sodium dinitro-ortho-cresol thoroughly applied when the petals were beginning to drop has given good results in continued tests both for improvement in the current crop and in correcting the alternate-year fruiting habit. Equally good thinning results were obtained from equivalent concentrations of this active ingredient as a powder in water. Tests at Ft. Valley, Georgia, with wire brushes and brush brooms for thinning young peaches in the bloom were successful. These methods greatly reduce the amount of labor required, and results appear almost as good as from hand thinning of the peach fruits. In further work on treatments to reduce fruit dropping, growth chemicals applied as dusts or Aerosols, were found very effective. These methods of application require much less labor than liquid spraying.

Introduced fruit varieties promise increased resistance to cold and disease: In tests on some two hundred introductions of peaches unusual cold resistance was discovered in clones obtained from the Caucasus region of Russia. As high as 72 percent survival was observed at winter temperatures which completely destroyed the buds of standard varieties. The same strains have shown remarkable resistance to spring frosts. In addition to Shalil and Yunnan peaches, which have already been demonstrated as highly resistant to root-knot nematode, nine additional introductions have shown this characteristic in screening tests at the Introduction Gardens. Several apple varieties have shown greater resistance to spring frosts than the standard variety Rome Beauty and may be of value in the development of late-blossoming varieties.

Citrus, Avocado, and Other Subtropical Fruit Investigations:

Emergency production of oranges increased by girdling: Experiments for three years with Washington Navel orange trees in California have shown that yields can be increased by from 20 to 50 percent in the crop following trunk girdling at blossom time. However, this increase cannot be maintained over a term of years by this emergency method. Valencia oranges respond in a similar way to girdling, but yields of Marsh grapefruit and of Lisbon lemon have not been materially increased.

Method for early recognition of "false hybrids" will facilitate citrus breeding: A method has been developed to distinguish in their first year of growth between truly hybrid citrus seedlings and the so-called false hybrids which are developed only from seed-parent tissues and have no value in breeding work. The method involves making a simple color test with certain chemical reagents on an extract from a small leaf sample. Early elimination of the false hybrids by use of this method will expedite the citrus breeding program.

Date palms on very sandy soils respond to more frequent irrigation:
Recent results indicate that reduced availability of soil moisture is an important factor limiting vigor and productivity of palms on certain deep sandy soils lacking moisture-retentive silty material. On such soils more frequent or nearly continuous irrigations are giving best results. Field fertilizer trials in the Coachella Valley of California have continued to give negative results, indicating that there is at present no important general fertility deficiency limiting the growth and yield of date palms in that region.

Nut Investigations:

Adequate nitrogen level required for high yields of pecans: In cultural experiments with pecans in Louisiana which included young trees of three standard varieties, the nut crops for six seasons, 1938 to 1943, averaged 423 pounds per acre per year for the plots given a cultural treatment that maintained a high nitrogen nutrient level. The high nitrogen level was economically supplied with legume winter cover crops fertilized sufficiently to produce good growth and turned under at the proper time for greatest benefit to the trees. Trees growing in permanent Bermuda grass sod had the lowest nitrogen level and averaged only 94 pounds of nuts per acre per year. Plots with two cultural practices that produced intermediate levels of nitrogen gave averages of 267 pounds when intercropped with cotton, and of 146 pounds when Bermuda grass sod was broken and legumes planted.

Walnut and filbert diseases: Disease control studies show that walnut bacteriosis can be successfully controlled by 3 or 4 properly timed and thorough applications of a Bordeaux mixture relatively low in lime or by more frequent applications of copper-sulfur dusts. Filbert bacteriosis can be controlled by 1 or 2 Bordeaux applications in late summer. Many materials other than those containing copper have been tested against these diseases but they have not proved as effective as the copper sprays and dusts.

Boron treatment continues to correct English walnut disorder: A disorder of Persian (English) walnuts, known for more than 20 years to occur in orchards on certain soils in the Pacific Northwest and called variously dieback, snakehead, baldhead, and winterkill, as well as an associated leaf-scorch condition, is being corrected by relatively heavy applications of borax broadcast around the trees. In one instance trees after treatment averaged 185 pounds of nuts per tree in 1943, while similarly affected untreated trees yielded 29 pounds per tree. These outstanding results have attracted wide attention, and growers are making extensive use of the borax treatment. Work is continuing on methods and amounts of application to get prompt recovery without injury to the trees from excess of borax.

Leaf analysis leads to correction of tung nutrient deficiencies:
Analysis of tung leaves to determine their content of various mineral nutrient elements has provided the clues that led to the solution of two nutrient deficiency problems, with consequent material increase in

production of some of the older orchards. In one case the deficient element was magnesium, and the condition induced by its lack has been found to be rather general in several counties in Florida. The leaf analysis technique makes it possible to detect incipient magnesium deficiency before definite symptoms have appeared in the foliage, and thus forestall a gradual decline in production. The solution of the copper deficiency problem has been similar to that of magnesium, but in this instance the deficiency is not so general in the orchards. The use of this technique is proving advantageous in advising growers on their fertilizer problems.

New tung strains show promise: The continued good performance in the 1943 and 1944 seasons of 4 and 5-year-old seedling tung trees, from selected parent trees, following the production of a heavy crop at three years of age and a severe freeze in March, 1943, emphasizes the potential value of these new strains to the industry. At four years of age trees budded with high-producing strains are showing outstanding uniformity and high productivity, and the early release of the best of these is planned.

Vegetable Investigations:

High-yielding sweetpotato varieties: Cooperative tests for three years in nine locations in principal sweetpotato areas in the Southeast show that two new seedlings and three introductions from Australia consistently have higher yields and more starch per acre than any varieties now grown commercially. In these sweetpotatoes, high starch content has been shown to be a strongly fixed varietal character. Percentage of starch increases with the longer growing season from Maryland southward. Drought reduced the starch content, but rainy seasons did not. Some of the highest yielding varieties are resistant to wilt.

A new lettuce variety shows adaptation for many regions: The Great Lakes variety of lettuce, developed by the Michigan Experiment Station in cooperation with this Bureau from breeding lines originating in our breeding project, has proved to have wide adaptation for the north-central to northeast parts of the country. It is also particularly suited to the central valleys of California during parts of the season when other varieties are not satisfactory, and to the Georgia coastal region where conditions are too severe for most lettuce varieties. This variety is thus extending the profitable growing season and growing area for head lettuce.

Emergency vegetable seed production in new areas: The practicability of extending profitable production of carrot and table beet seed to the "Eastern Slope" in Wyoming and Colorado is indicated by the results of trials during the past two seasons. Various areas in Utah have also been shown to be promising for carrot seed production. Use of these new areas will spread the risk in production of seed stocks as well as afford new acreage, not readily available in the old production areas, to meet emergency demands for seed. Results of the tests to date have been summarized for the immediate use of the seed industry.

Vitamin C loss in dehydration of vegetable varieties: Vitamin C determinations before and after dehydration were made on the important varieties of a number of kinds of vegetables. Dehydration loss of vitamin C varied greatly among varieties and for the different kinds of vegetables, in a range from 90 percent to 40 percent loss. Sweetpotatoes, okra, and some varieties of pumpkin had relatively high original vitamin C content and suffered smallest losses, ranging from 40 to 60 percent. Other pumpkin varieties and sweet corn also lost about half but had much lower original levels of vitamin C. Carrots and summer squash lost most heavily and also had low original levels. Snap beans also lost very heavily, but from a relatively high level. Sulfur dioxide treatment increased retention of vitamin C in green material, like snap beans and summer squash, but not in carrots, sweetpotatoes and pumpkins.

Germination of lettuce seed helped by seed treatment: A simple method of treating seed with weak solutions of thiourea makes possible the satisfactory germination of many kinds of lettuce seed at temperatures of 85° to 90° F., whereas untreated seed of the same lots showed only a trace of germination at these high temperatures. Such treatment will be useful in extending the possible planting season of certain varieties of lettuce to warmer periods, as in planting the latter part of the summer for a fall crop.

New strains of peanuts give higher yields: Three superior strains of the Spanish type of peanut have been developed and tested cooperatively by the Georgia Experiment Station and this Bureau. They are selections from variety crosses made many years ago by the Georgia workers. They out-yield current standard kinds by 15 to 20 percent and produce 50 to 100 pounds more oil per acre on good land. These strains are being increased on a commercial scale for release through organized channels.

Profitable increases in yield have been obtained by planting both Spanish and Runner peanuts at twice the currently practiced rate of seeding. The yields much more than pay for the extra cost.

First hybrid-seed onion variety is introduced: A method has been developed for obtaining the highly prized hybrid vigor in onions through the production of suitable hybrid seed in quantity. This has been achieved by the breeding of male-sterile onion strains that are capable of bearing seed but do not supply pollen. When such onions are interplanted with a strain of another variety producing normal pollen all of the seed borne by the male-sterile plants will be hybrid seed. If the strains for crossing are well chosen, this hybrid seed will give uniform, vigorous plants with high bulb yield. Male-sterile lines of the important onion varieties are being bred and made available to cooperating agencies.

The first hybrid-vigor onion variety, California Hybrid Red No. 1, has been developed in cooperation with the California Experiment Station. The parents are the male-sterile Italian Red 13-53 and Lord How Island. It is adapted chiefly for growing as a winter crop in the Southwest where it has given very high yields of very uniform onions.

Potato Investigations:

Two disease-resistant potato varieties are introduced: Under the cooperative National Potato Breeding Program two new varieties were named in 1943. Potomac is a late variety, somewhat resistant to leaf hoppers and flea beetles and to late blight, that has proved to be very productive at the high elevations of western Maryland. Menominee is highly resistant to common scab and moderately resistant to late blight. In quality and productiveness it is good but not outstanding. It gives high yields of No. 1 grade potatoes in parts of Michigan where scab has become a limiting factor in potato production with other varieties.

At present about one-third of all certified seed potatoes is of varieties introduced during the past 11 years in the cooperative breeding program. The availability of these improved varieties was an important factor in the production of potatoes in 1943 and 1944.

Fertilizer materials can be conserved in potato production: Field tests in Maine, New Jersey, Pennsylvania, and Virginia showed that "spent acid" superphosphate fertilizers are capable of producing as high yields of potatoes as superphosphate made with clear sulfuric acid. This is important in conserving clear sulfuric acid for war and industrial use.

The fertilizer investigations conducted in Maine revealed the possibility of using less phosphorus in potato fertilizers in certain soils, thereby conserving this material. The generally used 1-2-2 NPK ratio can be changed to 1-1.5-2 in most cases without loss of production. This is highly important in view of decreased supplies of agricultural phosphate in 1944-45.

Waste potato piles start late blight infection: Cooperative investigations in Maine have shown that potato cull or dump piles are primary sources of late blight infection. Spread from these has been evident early in the season and as much as one-half mile away. Sprouts from the discarded tubers in the dumps should be destroyed by chemicals or by burning over with straw before blight can spread to the fields. More effective measures would be to incinerate waste potatoes, or cook them before dumping, or feed them to hogs.

Early harvesting reduces virus diseases in potato seed stocks: In production of disease-free seed potato stocks early harvesting by lifting potato vines before aphids carrying virus diseases become plentiful has been found to give excellent results. Another method is to spray at the proper time with weed-killing chemicals to kill the tops. This requires less labor than the method of vine pulling. These methods of circumventing virus vectors are important in producing foundation seed stocks in sections such as Aroostook County, Maine, where the certified seed is produced in close proximity to extensive table-stock plantings.

Golden nematode of potato: This new pest, first found in 1941 on Long Island, continues to be a serious threat to potato production in that area. Yield losses exceeding 50 percent were observed in tests during the 1943 season. A one-year rotation reduced infestation by about 20 percent. No potato varieties tested have been found immune or resistant, but early varieties, such as Cobbler, Warba, and Chippewa, gave significantly higher yields, apparently because they made considerable growth in cool spring weather before the nematode is very active. Certain soil fumigants tested in the 1943 season gave reasonably good control, but none of them appeared to be economically feasible. Tests made in the 1944 season with the promising new soil fumigant called D. D. mixture gave promising results, and larger-scale tests will be made next season. D. D. mixture is relatively low in cost and may prove practical for use on more valuable crop land.

Ornamental Plant Investigations:

The investigational program on ornamental plants and nursery production has been placed on a curtailed basis for the duration.

Certain newly developed large-flowered Easter lily varieties matured bulbs at Beltsville, Maryland, by the first week of August, and these could be forced for flowering by the first week of December, whereas the parent stock of Creole Easter lily was a month later in maturing bulbs and almost two months later in flower forcing. One free-flowering clonal line produces an average of 10 flowers per 3-inch bulb. The rapid propagation of these superior clonal lines by means of bud scales has been greatly aided by the discovery that a combination treatment with a suitable fungicide and a growth-promoting substance stimulates the bulblet formation and growth much more than the same materials used separately. These improved varieties will form the basis of an American Easter lily industry. About 90 percent of the bulbs formerly came from Japan.

New organic fungicides now becoming available give great promise of controlling the azalea flower spot disease without disfiguring the blossoms.

Methods of Handling, Transportation, and Storage, and Market Diseases of Fruit, Vegetables, and Flowers:

Improved methods reduce costs in shipping frozen fruits and vegetables: For transcontinental shipment of frozen fruits and vegetables, refrigerator cars with overhead bunkers maintained very uniform temperatures safely below the 20° F. maximum limit for security from thawing, whereas in cars with the usual end bunkers temperatures ranged up to 23° and varied considerably in different parts of the load. It was found that the precooling of the cars before loading could be satisfactorily done in 14 hours instead of the customary 36 to 48 hours, at a considerable saving in costs.

Refrigeration is beneficial in shipping southern-grown tomato plants: It has been shown that carload shipments of tomato seed-bed plants from Georgia to New Jersey and Pennsylvania during hot weather should be under refrigeration, especially during the early part of the trip, instead of being moved with the customary ventilation service. As a result of 20 carload shipping tests made in 1943, practically all shipments moved under ice in 1944, or else within limits of safe transport in ventilated cars. The delivery condition of the plants shipped under partial refrigeration is much superior to that of plants shipped entirely under ventilation.

Carbon dioxide reduces decay in shipments of snap beans: In the control of watery soft rot of snap beans which has come to be a very serious problem in shipments from southern Florida, promising results have been obtained in shipments with dry ice as a source of carbon dioxide. Use of 25 percent carbon dioxide during the first 24 hours of transit, without refrigeration, reduced the transit loss by two-thirds.

Storage temperatures of vegetables for dehydration determine quality of product: Cold storage of onions for dehydration gave a gain over common storage of 44 percent in the yield of dried product, largely because of better control of decay; but appearance and quality of the final product from the cold-stored onions were also superior. In the storage of potatoes for dehydration the best-quality product was from stock held at 50° to 60° F. At lower temperatures the potatoes developed excessive amounts of sugar and became undesirably darkened during dehydration. With sweetpotatoes the best dried product was from stock stored at 55° F.; even a few days' exposure to temperatures below 50° resulted in a poor-quality product.

Prevention of citrus decay: Further investigations on methods of reducing losses in citrus fruits from decay have shown that vapors of diphenyl inhibit the growth of fungus organisms that cause most serious losses. Impregnating fruit wraps, box liners, fruit dividers in fiberboard cartons or shredded paper scattered through the pack with diphenyl has reduced decay. Dipping fruit in solutions of thiourea has also proved highly effective in decay prevention.

Drug, Oil, Insecticide, Tannin, Flavoring, and Related Plant Investigations:

Drug, and related plant specimen garden becomes important as source of materials: Of practical importance to the many people interested in growing drug, condiment, and oil-yielding plants is the specimen garden developed and maintained at the Plant Industry Station, Beltsville, Maryland. Over 200 species and varieties of the large number of plants used for their drug and condiment properties have been assembled and grown in a specimen garden. In many cases these plants have become the only reserve stock for supplying propagating materials of plants not commonly grown in this country. Observations and records

made to determine the behavior and growth habits of these plants under existing soil and climatic conditions have proved extremely valuable as a guide for handling such little-grown plants in this country. Seed and planting stock of authentic and tested varieties have been an invaluable source of propagating material for many of the unusual plants such as Japanese peppermint, belladonna, digitalis, Dalmatian sage, tarragon, pyrethrum, paprika, and many others. This reserve of plant material is of importance both to growers in the continental United States and as an important source for propagating material for expansion in other countries of this hemisphere.

Variety studies of sage and coriander are revealing a wide range of quality and usefulness for flavoring purposes: Work on the development of varieties of these plants that possess the quality desired by the trade has made good progress and several superior types are now being tested. These and several other condiment plants have possibilities of becoming permanently established in favorable localities, and their adaptation to specific conditions is being determined. To assist in meeting the many requests received from home gardeners, a bulletin on the growing of flavoring herbs and their uses is in preparation in collaboration with the Extension Service and the Bureau of Human Nutrition and Home Economics.

A species of basil under test yields up to 200 pounds of camphor per acre from first year cultivation: Camphor basil can be grown as an annual crop in many sections of the country, and could become a commercial source of natural camphor, which is now produced only in Japan from the camphor tree. Studies are under way to determine practical methods of propagating, harvesting, and distilling this crop, and to develop strains of the plant with a consistently high camphor content.

Improvement by breeding and selection prepares way for domestic production of insecticides: With the increased demand for large amounts of effective insecticides which are non-poisonous to man, the problem of developing suitable domestic sources assumes new importance. Extensive research on many plants of the world has revealed only one species that can be grown in the United States which yields any substantial amount of rotenone for insecticidal purposes. This species is Tephrosia Virginiana, commonly called devil's shoestring, which is widely distributed throughout the eastern and Gulf Coastal states.

A cooperative breeding and selection program previously reported has now produced a population of plants which consistently yield about 2-1/4 percent rotenone in the roots, with a yield of approximately 2,500 pounds of dried roots per acre. Through breeding and selection many strains of these plants with a wide range in rotenone content have been developed. Approximately 8 acres of these strains are now available, and assays are being made to select out those strains of greatest promise. Much of the material now developed has more than 2-1/4 percent rotenone and a considerable number of the strains

developed in the breeding program contain as much as 8 and 9 percent rotenone. When these high yielding strains can be field tested and increased they will be of major importance in supplying planting stock which can be grown on sandy soils in the Gulf Coastal states for insecticides for local use, and offer the possibility of materials for commercial production of insecticides of domestic origin.

High quality domestic seedless hops supply wartime need of previously imported materials: Pre-wartime production of hops in this country amounted to approximately 39,000,000 pounds annually. About 8,000,000 pounds were imported from foreign countries for high grade hops, most of which were of the seedless type. Wartime demands have increased the need for high quality hops which are now supplied entirely through domestic production.

Production of seedless hops in the continental United States has greatly increased, and for the most part is replacing the high quality hops previously imported. A large number of European varieties of hops have been grown in experiment yards where their quality can be determined and evaluation made of the existing varieties grown to produce seedless hops. Several thousand seedlings and selected plants are now being grown under experimental conditions to determine their relative value based on comparison with foreign hops. Investigations have demonstrated that high seed content is associated with low content of alpha resin, the chief constituent of value in hops. This finding is important in revealing the true relative values of seeded and seedless hops, and should help to establish price differentials to make it worthwhile for growers to produce domestic seedless hops.

(e) Forest Diseases

Appropriation Act, 1945	\$255,300
Proposed transfer in the estimates from "General administrative expenses"	<u>10,700</u>
Total available, 1945	266,000
Budget estimate, 1946	<u>232,700</u>
Change for 1946:	
Overtime decrease	-33,300
No other change	<u>-33,300</u>

PROJECT STATEMENT

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
1. Diseases of coniferous and broadleaf trees and forest products:				
(a) Diseases affecting turpentine pines	\$ 10,434	\$ 10,040	\$ 10,040	\$ - -
(b) Little-leaf disease of southern pines	15,355	15,400	15,400	- -
(c) White pine blister rust..	13,724	14,720	14,720	- -
(d) Dutch elm, phloem necrosis, and other elm diseases	32,602	26,570	26,570	- -
(e) Maintenance of blight- resistant chestnuts and evaluation for tannin production	14,788	16,170	16,170	- -
(f) London plane disease	4,470	- -	- -	- -
(g) Diseases of fir, pine, oak, and other trees, affecting wartime lumbering	49,449	49,700	49,700	- -
(h) Detection and avoidance of: sapstain, decay, and other disease defects in forest products used in boats, air- craft, and other construction:	91,105	93,090	93,090	- -
(i) Giant cactus disease in the Saguaro National Monu- ment	7,042	7,010	7,010	- -
2. Overtime costs	33,510	33,300	- -	-33,300 (1)
Unobligated balance	2,421	- -	- -	- -
Total estimate or appro- priation (1944 and 1945 adjusted for compara- bility)	274,900	266,000	232,700	-33,300

DECREASE

(1) Decrease of \$33,300 due to elimination from the 1946 estimates of the estimated fiscal year 1945 overtime cost.

CHANGE IN LANGUAGE

The estimates include the following proposed changes in the language of this item (new language underscored, deleted matter enclosed with brackets):

Forest [pathology] diseases: For [the investigation] investigations of diseases of forest and shade trees and forest products, [including a study of the nature and habits of the parasitic fungi, bacteria, viruses] and [other causes of such diseases, for the purpose of developing] methods [of] for their control [and eradication and determining their application, \$255,300], \$232,700.

The change in title and revision of language for this item are proposed in the interest of simplification and brevity. No change is intended in the nature or scope of the work now being conducted.

WORK UNDER THIS APPROPRIATION

Objective: The broad objective of the work in forest diseases is to increase the value of trees and to enhance the returns from timber and forest products, by reducing the occurrence of diseases and decay. Currently important aims are to preserve the health of forest and shade trees and to prevent damage from decay organisms to wood used for military and civilian purposes. Immediate objectives include (1) development of tree varieties resistant to specific diseases, (2) adaptation of forest-management practices to the avoidance of losses from heart rot and other diseases, (3) improving methods of inspection and grading to avoid deteriorated wood without needless rejection of valuable material, and (4) developing improved practices which will prevent decay in aircraft, ships, military and civilian buildings, and other places where wood is used. To attain these objectives, attention is given to the causes of disease and deterioration, to the factors by which they are influenced, and to methods of their control.

The Problem and Its Significance: Diseases cause great damage in forests. Heart rots alone make it necessary to cull more than an eighth of the gross volume of the annual saw-timber cut. Diseases not only destroy wood but increase logging costs and labor requirements because many trees when cut are found to have too little sound wood to cover the expense of felling and bucking.

It is important not only to combat disease but also to learn how to better estimate the damage already done. Recent trends in forestry intensify these needs. Fortunately, partial cutting is being substituted for clean cutting in many areas. In relatively few timber species is it now possible to tell which trees are decay-labile and which can be safely left standing until a later cutting, or how much the wounds made during selective logging increase the decay hazard

to the trees left standing. Improvement operations in second-growth stands may fail if disease aspects are neglected. Forest and erosion-control plantings are hampered by diseases that dwarf or kill young trees. Disease epidemics destroy shade and ornamental trees, leave city streets without trees, and reduce property values. Much of the lumber now being sold is from second growth and has a high proportion of sapwood, which makes it liable to decay. New problems have arisen in the protection of boats, aircraft, wooden buildings, and of wood and fiber containers for use of the armed forces in the Tropics. Wartime requirements for rosin and turpentine call for a 35 percent increase in 1945. This necessitates the development of safe methods for stimulating resin flow and for controlling diseases that affect the freshly cut faces of trees.

General Plan: This work is directed almost wholly to the solution of current disease problems in connection with timber management, wood utilization, and destructive forest and shade tree disease epidemics. Laboratory and controlled field tests are conducted in cooperation with the Forest Service, the Soil Conservation Service, the Bureau of Entomology and Plant Quarantine, the National Park Service, State experiment stations, municipalities, and nurserymen. Most of the field workers are located at Forest Service headquarters.

Examples of Progress and Current Program:

Pathological factors in the production of turpentine and rosin:

The greatly increased need for naval stores in 1945 can be met only by increased labor supply or by chemical stimulation of the gum flow. Chipped surfaces are sometimes affected by a disease called "dry face." Chemical stimulation may produce a false dry face. The wood of chipped trees often becomes resin soaked and is degraded for use as lumber. In cooperative studies with the Forest Service, it has been shown that dry face and resin soaking may be the result of fungus activity, and several fungi are being tested to determine whether any one is the causal agent. False dry face does not result in decreased yield of resin. The term has been contrasted with true dry face so that the conditions may be differentiated in the field. Acid-treated trees, after three full seasons, are not different in crown appearance than those chipped without treatment.

An anatomical study of unturpented pines, of trees normally turpented, and of pines that have received stimulatory chemical treatments has been started to determine the effect of these treatments upon dry face and the processes involved in gum production.

Fusiform rust of southern pines: Fusiform rust, which spreads from oak to pine, is one of the causes of understocked stands of loblolly and slash pines in the southeastern States. It has damaged 30 to 57 percent of the trees in a large slash pine plantation studied. It kills seedlings and causes cull from stem cankers on the larger trees. The rust may form its spores very rapidly on the oak, even in as few

as 7 days. This bears on the spray control program in nurseries. In natural stands and in plantations, removal of cankered branches before the rust reached the main stem was found advantageous, but removal of stem or bole cankers seemed of little value. Preliminary tests with controlled burning when plantation trees were 10 to 20 feet tall resulted in killing many of the limb cankers that otherwise would attack the main stem. This burning also killed to the ground most of the undesirable oak and other hardwoods.

Little-leaf disease of southern pines: The effort to find the cause of this disease is continuing. Two root fungi have been isolated from diseased trees, which kill slash pine seedlings in pots, but their effect on large trees must await results of inoculations. A large number of grafts have been made to determine whether the disease is caused by a virus, but they have not yet produced results. Soil analyses and soil fertilization with both major and minor elements have indicated no consistent relationship between the disease and soil conditions, although some improvement has been induced by the addition of borax and nitrogen. The disease is now known in Virginia, the Carolinas, Georgia, Alabama, northeastern Mississippi, and eastern Tennessee. There are approximately 11,000,000,000 board feet of shortleaf pine on about 41,000,000 acres in the region where little-leaf occurs. New areas have been discovered and the disease is intensifying in previously known areas. The incidence and destructiveness have been studied in detail on 34 plots in five of the States mentioned and in one plot in Arkansas. Of these, 25 were diseased plots and 10 showed no signs of little-leaf disease when laid out. Annual death losses run as high as 11 to 21 percent.

The possible value of eradication for control of little-leaf is being tested in the Sumter National Forest in South Carolina. On an experimental area of 1,000 acres in this forest, 12 percent of the trees were affected by little-leaf in the spring of 1944 and are being removed. Frequent inspections of the area are made and newly affected trees are removed as fast as they develop positive symptoms. On a comparable check area diseased trees are marked but left standing. Incidence of new cases of the disease on the controlled and the check areas will be recorded. A comparison of results from the two areas should show whether immediate selective logging of diseased trees is advisable.

Recommendations have been made regarding the management of timber stands affected by little-leaf. To salvage timber before the trees die, partial cuttings should be made as often as volumes of diseased trees are available in operable amounts. In severely affected stands this may be every 5 years. It should not exceed 7 years in any little-leaf stand, unless the cost of cutting is excessive. These practices will generally result in the complete removal of the original stand at an age of not much over 50 years.

Dutch elm disease, phloem necrosis, and elm mosaic: Phloem necrosis of American elm has spread westward into Missouri and Kansas and serious losses have occurred in these States this year. Devastating outbreaks have continued in Ohio, Indiana, and Illinois. State and local officials have requested cooperation in a program to develop control measures for this deadly disease. Large stocks of seedling varieties and strains of American elm have been assembled at Morristown, New Jersey; and Columbus, Ohio, for testing resistance to Dutch elm disease and to phloem necrosis. One resistant American elm has been discovered and two resistant hybrid elms produced. All available bud wood of these resistant elms and of a resistant European elm, Christine Buisman, is being used in propagating young trees for planting. Under the inoculation tests none of the elms secured from midwestern nurserymen and claimed to be hybrids showed resistance to the Dutch elm disease.

Study of the distribution of diseased elm trees in the vicinity of dying trees and wood piles, and results in pruning infected elms, suggest that it may be possible to protect valuable elms by local sanitation. This preliminary conclusion is to be tested by extensive field experiments in which dead and dying wood is removed from the valuable elms to be protected and from all other elms within 1 mile. The results of transmission tests indicate that in the virus-caused elm mosaic a virus complex rather than a single virus may be involved.

Blight-resistant chestnuts: Cooperative forest and nut-tree plantings, made mostly in the eastern States, are now being studied and the resistance of different selections to chestnut blight and the adaptability to tannin, pole, tie, post, and nut production are being determined. The best trees are being propagated and further tested for both forest and nut purposes. Results with some strains in forest plantings definitely indicate that they will be of value for the production of small telephone poles. In cooperation with Government, State, and private agencies such strains should now go into greatly extended plantings under various climatic and soil conditions. Sufficient seed can be obtained from selected introductions or strains to carry out such a program, but present facilities, especially in wartime, do not permit of this extension. The first and second generations of 1800 hybrids of Oriental chestnuts and American chestnuts are still too susceptible to blight, having less resistance than their Asiatic parents. These are being back-crossed to secure a higher proportion of the resistant Asiatic blood.

Disease problems in the National Forests: There are 160 National Forests, totaling over 176,000,000 acres. The Bureau assists the Forest Service in maintaining the health of these forests. Frequently, specific problems must be solved; some local, some covering large regions. For example, on request of the Forest Service, a study was made of defects in Douglas-fir on a timber sale in the Trinity National Forest in California. Many trees initially designated by markers as unmerchantable were found to be only slightly defective. The usefulness of crown characters in judging probability of decay

was demonstrated. In mixed uneven-aged stands of Douglas-fir, western hemlock, and silver fir, the two latter species are frequently injured during selective logging. On 26 western hemlock trees, on a site cut over 12 years earlier, 52 out of 56 wounds have been invaded by decay-producing fungi. These facts are taken into consideration in timber sales, since the choice as to the type of cutting depends largely on what will happen to the reserve trees. A serious loss of ponderosa and other pines in several western States is found to be caused by a species of Leptographium fungus that attacks the roots and the lower trunk. In the West some of the dying of coniferous trees, formerly attributed to bark beetles, has been found to be due to the root fungus Fomes annosus. Further research is being conducted to determine the effects of these diseases as related to possible changes in forest management.

Decay resistance of oak wood: For three species of the red oak group tested it has been determined that the heartwood has a uniformly low decay resistance. Heartwood of the species of the white oak group tested has, in general, moderately high decay resistance. But differences among the white oak species themselves are substantial. Heartwood from upper logs appears more resistant than from lower logs, and outer heartwood is markedly more resistant than inner. Sapwood of all oak species should be avoided where decay resistance is needed. Other species of oak need study. Information developed from these decay studies has been used by the U. S. Coast Guard, the Bureau of Ships, the Engineering Branch of the War Department, and the Maritime Commission. Further studies of effect of various factors on decay of wood in boats are under way, in cooperation with the Philadelphia Navy Yard test laboratory.

Decay prevention in wood aircraft in use: The research reported last year culminated in two publications on the decay of wood in aircraft, presenting the results to the aircraft industry and to the military forces. This year there have been requests from the military forces for assistance in applying the results. Groups of defective airplane and glider parts have been assembled at repair stations and factories, and pathologists have visited them in company with Army officers and Forest Service experts, and advised as to what could be safely used. Slight further changes in design to alleviate decay hazards have been recommended. The situation is much better than at the time of first contact with the problem. As the demand for this work diminishes, studies on defects and decay prevention in wood for other uses will be correspondingly increased.

Defects in lumber: As reported last year, discolorations of many kinds are found in various kinds of woods employed in aircraft and other exacting uses. They are abundant in yellowpoplar, sweetgum, yellow birch, and American beech, and there are a few in mahogany and khaya. Our studies have shown that some of these discolorations indicate decay or weakness, but that the majority do not. The aircraft and other industries are vitally interested in correctly evaluating these discolorations, in order to avoid unnecessary rejection of high

quality material. Dozens of samples of veneer and lumber have been received from the Inspection Service of the Army Air Forces, the airplane industry, and other sources for diagnosis. Mimeographed descriptions and hundreds of sets of veneers showing the relation of discolorations to decay have been placed in the hands of inspectors.

Durability of glued and plasticized wood products: Delamination of glued joints in boats, aircraft, and material containers has caused damage and uncertainty as to construction techniques. Containers for food supplies, ammunition, and equipment for the armed forces in tropical operations are frequently subjected to conditions highly favorable to fungus action. The usefulness of wood and pulp products impregnated with synthetic resins and of compressed and heat-stabilized wood depends largely on their degree of resistance to micro-organisms. Samples of commercial fiberboards subjected to the action of mold fungi did not decrease in bursting strength but were significantly reduced in tensile strength. Tests were made and results reported to Army Ordnance on chemicals for protection of both wood and fiber containers. With probable great future development in plywoods after the war, knowledge of the effect of decay fungi and bacteria on plywood and plywood glues and resins is becoming increasingly important. A standardized procedure for measuring the mold resistance of protein glues has been developed and recently published in collaboration with the Forest Service, and further extensive tests are now under way.

(f) Soils, Fertilizers, and Irrigation

Appropriation Act, 1945, (none under above title)	- -
Proposed transfers in the estimates from the following appropriation items within the Bureau:	
General administrative expenses	+\$29,413
Dry-land agriculture	+217,038
Irrigation agriculture	+141,600
Soil and fertilizer investigations	+346,791
Soil survey	+162,582
Total available, 1945	897,424
Budget estimate, 1946	913,000
Change for 1946:	
Overtime decrease -118,084	
Increase +133,660	+15,576

PROJECT STATEMENT

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
1. Soil management and fertilization for crop production	\$148,443	\$140,460	\$140,460	- -
2. Irrigation practice, drainage, and salinity control	116,361	125,590	259,250	+\$133,660 (1)
3. Dry-land management ..	191,205	192,950	192,950	- -
4. Soil classification for crop production	149,505	147,450	147,450	- -
5. Fertilizer materials and improvement	165,764	172,890	172,890	- -
6. Overtime costs	120,233	118,084	- -	-118,084
Unobligated balance	16,513	- -	- -	- -
Total estimate or appropriation (1944 and 1945 adjusted for comparability).....	908,024	897,424	913,000	+15,576

INCREASES OR DECREASES

The net increase of \$15,576 for 1946 consists of the \$118,084 decrease for overtime and

(1) An increase of \$133,660 to obtain information to guide development and insure permanency of production on newly irrigated lands of the Lower Colorado and Columbia Basins:

Objective: To insure initial success and permanency of crop production on the newly irrigated soils of the Lower Colorado and Columbia Basins.

The Problem: The Lower Colorado Basin. The successful irrigation of some desert valley lands in the Southwest, including such lands in the Lower Colorado Basin, is not in itself a safe basis for assuming that all lands in the Lower Colorado Basin can be developed under similar practices into productive irrigated areas. Experience in the preliminary development of desert mesa lands, has demonstrated that these lands are entirely different from the valley lands, and that certain problems must be solved before the mesa lands can be expected to maintain a successful agriculture. Desert valley soils are in general relatively fertile and respond satisfactorily to cropping and irrigation practices. The raw mesa soils on the other hand, low in both water-holding capacity and in natural productivity, require not only unusual skill in irrigation and in all cultural operations but also the use of fertilizers to produce crops. The problem is further complicated by the presence of soil-borne diseases and nematodes which seriously interfere with normal crop development. The irrigation of the mesa lands also introduces complications into the agriculture of adjacent valley lands because of the possible effect of excess drainage waters moving into the lower areas with serious results on water table, salinity, etc. Even on some valley lands serious problems are encountered, as in the transition from well to ditch-water irrigation with different salt content in the Coachella Valley.

Various projects planned for development in the post-war period involve some 1,000,000 acres of mesa and other lands which it is expected will eventually be thrown open to settlement. While certain of these lands can be settled with no more than the customary difficulties to be expected in opening a new irrigation district, part of the area, and the mesa lands specifically, is likely to present serious obstacles to prospective settlers, unless exact information is obtained relative to the crops which can be grown, the irrigation and cultural practices to be followed, the methods of applying water, soil-management practices, how to maintain laterals and farm ditches, the movement of subsoil water, how and what to apply to correct soil-fertility deficiencies, how to control soil-borne diseases and nematodes.

The Columbia Basin. The problems of the Columbia Basin are likewise serious, although distinctly different from those of the Lower Colorado. A wide diversity of soil and growing season exists in the more than 1,000,000-acre project. Irrigable soils vary from loamy sand to silt loam many containing large amounts of fine or very fine sand in the surface soil. All are low in organic matter and tend to blow if the surface is disturbed. The more sandy soils have a low water-holding capacity. Great diversity exists in the subsoils. Some are deep with little compaction, while others are quite compact. Some are characterized by lime hardpan at varying depth, some by a gravel or coarse sand substrata. Some are quite fertile, some only moderately so. Drainage varies, as does salinity. Length of growing season ranges from 135 to 190 days, with corresponding differences in maximum and minimum temperatures. Types of farming and the kinds of crops to be grown under these widely variant conditions must likewise be different. The crops to be grown, methods of irrigation, the amount of water to use on the different crops on different soils, methods to prevent wind and

water erosion, drainage requirements, salinity control, and possible fertilizer requirements for the more sandy soils in particular, are items of information that should be available to the more than 12,000 prospective settlers.

Significance: Reclamation in the Western States contemplates further development of the Lower Colorado area, under the All-American Canal and the Coachella branch of this canal which will carry water in part to new lands. This project is expected to open some 500,000 acres and to provide farms for some 3,000 families. In addition, the Gila project in Arizona, embracing an ultimate 585,000 acres, has been authorized. Ultimately this area is expected to provide farms for another 3,500 families. The proposed Columbia Basin Project is reported to cover some 1,034,000 acres, or enough land to provide farms for close to 13,000 families. The prospective success of close to 20,000 farm families and the security of large investments will be greatly influenced by the availability of sound information to prospective settlers on the farms of these two areas.

Plan of Work: The research program (covering field studies of crop adaptation, soil management, irrigation practices, and crop water use, soil-water relations, plant-disease and nematode control, etc.) will be carried out on representative soil types in the areas. Cooperation is contemplated with the Bureau of Reclamation, the Soil Conservation Service, and the State Agricultural Experiment Stations of Arizona, California, and Washington, depending on the area involved. Information will be made available as rapidly as possible to Extension and other agencies responsible for transmitting it to farmers.

The work in Washington will be centered at the Washington Branch Experiment Station at Prosser. The State of Washington has recently purchased 258 acres of land in the new Roza Project which is just now being opened for irrigation. This land is just 2 miles north of the present station. The soil, Ritzville silt loam, is one of the better soil types found in large areas of the eastern part of the Columbia Basin. Studies on this new land can be conducted from the present station and findings will provide advance information for settlers in the Columbia Basin. As the Basin is developed research will be projected into the area proper, but to a large extent it, too, can be conducted from headquarters at the present station since all of the Basin is within 75 miles of Prosser. However, it will be necessary to establish some outlying fields for controlled studies. This land will be made available by the Reclamation Service or by arrangements with farmers.

The Umatilla Station at Hermiston, Oregon, has a soil similar to the soils in the western and southern parts of the Columbia Basin. This station will be utilized to carry out research applicable to similar soils in the Basin.

The State of Arizona operates a substation at Yuma, the Bureau has a substation at Bard, California, and California has a substation at El Centro. It is contemplated that one or more of these will be

utilized as headquarters in initiating research in the new developments of the Lower Colorado area. Research will be projected into the newly developed mesa lands in the manner discussed above under the Columbia Basin Project. Central service facilities probably will have to be developed in the Lower Colorado Area, since the present facilities at the substations mentioned appear inadequate. It seems desirable first to conduct exploratory studies to obtain additional information as a basis for determining the extent of the need and the best locations to serve the area.

CHANGE IN LANGUAGE

The estimates propose the following language for this item:

Soils, fertilizers, and irrigation: For investigations of soil management methods to increase and maintain productivity, including fertilization, liming, crop rotations, tillage practices, and other means of improving soils; fertilizers, fertilizer ingredients, and their improvement for agricultural use; soil management and crop production on dry and irrigated lands, and the quality of irrigation water and its use by crops; and for the classification of soils in a national system and indication of their extent and distribution on maps, and determination of their potential productivity under adapted cropping and improved soil management, \$913,000.

This item represents a consolidation of the present appropriations for "Soil and fertilizer investigations" and "Soil survey", together with research now being conducted under the appropriations for "Dry-land agriculture" and "Irrigation agriculture" which deals essentially with soil management and related problems; and a part of the item for "General administrative expenses". The appropriation language recommended is intended to provide the same authorizations for the research work involved as were provided by the 1945 Agricultural Appropriation Act.

WORK UNDER THIS APPROPRIATION

Objective: The broad objective of the research program on soils, fertilizers, and irrigation is to advance public and farm welfare through developing information, methods, and materials to: (1) maintain and rebuild the nation's vital soil resources; (2) maintain and increase fertility while producing crops on the most economical sustained basis; (3) serve in helping to effect adjustments in land use to meet changes in national requirements; (4) aid in insuring a more stabilized and profitable agriculture in dry-land and irrigated regions; and (5) increase farm income to encourage and support a high standard of living. More specific objectives are as follows:

(a) To develop soil-management methods, including fertilization, liming, crop rotations, tillage practices, and other means of improving soils to maintain maximum economical production on a permanent basis.

(b) To develop improved soil-management and crop-production practices that will make possible the most efficient use of limited rainfall on different soil types in the Great Plains and other semiarid regions.

(c) To devise effective irrigation and drainage methods and practices to maintain production, and determine corrective measures for injurious salt concentrations in soils and in irrigation and drainage waters.

(d) To classify soils in a national system, determining their potential productivity under adapted cropping and improved management, and mapping their distribution for use in applying improved soil management and land use on individual farms.

(e) To develop improved and cheaper fertilizers and more effective methods of use, with special effort during the war to assist in promoting the most effective use of fertilizer resources in meeting crop production goals.

The Problem and Its Significance: The basic problem in soil management is to maintain and improve soil fertility under cropping systems that are profitable and permanent for the wide range of soil types and climatic conditions in the United States. Abundant evidence points to widespread deterioration in the inherent productivity of American soils. This deterioration has in considerable measure offset the effects on crop yields that should have accrued from great improvement in crop varieties, the use of fertilizers, land drainage and more efficient cultural practices. This deterioration is occurring even on the best level lands where erosion is insignificant, although, of course, erosion has speeded the process greatly in many areas. Often erosion does not begin until the protective vegetative cover has been starved out by soil depletion.

Results of studies for a 31-year period by the Ohio Agricultural Experiment Station on Wooster silt loam soil show that a good management system yielded annual net returns of \$30 per acre and a poor system only \$7 per acre. Furthermore, soil productivity in the poor system is still declining at a rate estimated at 10 percent in 10 years, whereas soil productivity in the good system is being steadily increased. This illustrates what is happening to soils elsewhere in the nation under poor or indifferent soil management, and the possibilities for developing effective management practices. Proved methods of good soil management have been worked out for relatively few soils, and in most areas information is needed on the effects of present practices and what changes should be made.

War conditions involve many problems in connection with fertilizers and the use of soils. Imports of certain fertilizer materials have been cut off or made difficult. Problems regarding the supply of sulphuric acid have threatened the adequate production of superphosphate. Nitrogen demands for munitions have limited the quantity of nitrogen available for fertilizers. Transportation difficulties have made it necessary to change industrial equipment used in handling shipments and to alter the composition of fertilizer mixtures so as to

conserve transportation space. In effecting adjustments arising from these problems, Government agencies have cooperated with industry.

Problems which require a concerted attack include, among others: soil-management practices to improve soils and maintain productivity in all parts of the country, involving rotations, cover crops, green manures, and the use of soil amendments and fertilizers as related to different crops grown on different soil types; soil-fertilizer relationships, including methods to increase the availability of phosphate and potash fertilizers in certain soils; the development and maintenance of desirable soil tilth so essential in economic crop production and in the maximum conservation of soils; soil-management and fertilizer practices necessary to produce profitable crops under irrigation and on dry lands on a sustained basis; development of new fertilizer materials, fertilizer combinations, methods of manufacture, and testing the properties and values of fertilizers in order to reduce farm costs of fertilizers; classification and mapping of soils to provide information on the soils of individual farms which can be used to translate soil-management practices, fertilizer needs, and crop adaptation into the operations of each farm.

General Plan: Investigations relating to soil management and fertilization for crop production are being closely correlated with the work of State agricultural experiment stations. This is also true of the work with fertilizers, where, as a new fertilizer is developed, it is tested at several State stations, as well as at the Bureau's station at Beltsville, Maryland.

Cooperative dry-land management investigations are conducted at: (a) field stations maintained by this Bureau at Akron, Colorado; Huntley, Montana; Tucumcari, New Mexico; Mandan, North Dakota; Lawton and Woodward, Oklahoma; Newell, South Dakota; Big Spring and Dalhart, Texas; and Sheridan, Wyoming; and (b) at substations maintained by the respective States at Colby, Garden City, and Hays, Kansas; Havre and Moccasin, Montana; North Platte, Nebraska; Dickinson, North Dakota; Pendleton and Moro, Oregon; and Archer, Wyoming. At these stations facilities are provided also for work cooperative with various divisions of the Bureau, such as Fruit and Vegetable Crops and Diseases, Cereal Crops and Diseases, and Forage Crops and Diseases; with other agencies of the Department, such as the Soil Conservation Service; and with the State Agricultural experiment stations of the several States.

Irrigation-practice, drainage, and salinity-control investigations are conducted primarily at field stations, supplemented by necessary laboratory experiments. These field stations are located on Federal reclamation projects and the facilities available are used for cooperative investigations by other divisions of the Bureau of Plant Industry, Soils, and Agricultural Engineering, by the Bureaus of Animal and Dairy Industry, and by the several State experiment stations. The use of land and of irrigation water has been provided by the Bureau of Reclamation, and this agency also has contributed some buildings and special aid in land-leveling and ditch

construction. The field stations are located at Huntley, Montana; Newell, South Dakota; Scottsbluff, Nebraska; Fallon, Nevada; Bard, California; and Hermiston, Oregon. Cooperative investigations are conducted also at a State Branch Experiment Station at Prosser, Washington.

Investigations on salt constituents of irrigation and drainage water involve cooperation with corporate irrigation districts and the Department of Interior's Bureau of Reclamation, Geological Survey, and Office of Indian Affairs. These agencies collect samples of irrigation and drainage waters at appropriate gaging stations where the volume of discharge is regularly measured. These water samples with the discharge data are sent to the laboratory at Riverside, California, where the water is analyzed and the quantities of salt constituent conveyed past each station are computed. Thus the annual input and output of dissolved salts (the annual salt balance) of an irrigated district is determined. If, in any districts, the salt balance is adverse, that is, if the salt input exceeds the output, remedial measures are indicated.

Soil surveys are conducted cooperatively with appropriate State agencies, especially the State agricultural experiment stations, and with the Soil Conservation Service, the Tennessee Valley Authority, and other Federal agencies. In the fiscal year 1945, all field work on regular soil surveys is conducted by State soil survey organizations.

Scientists of the Bureau also cooperate with other public agencies in developing agricultural and land programs that involve needs for a knowledge of soil and for the interpretation of soil maps and other soil research. These cooperating agencies include the Bureau of Agricultural Economics, the Farm Credit Administration, the Soil Conservation Service, the Farm Security Administration, the Tennessee Valley Authority, the Forest Service, the Bureau of Reclamation, and the Bureau of Indian Affairs.

For effectiveness, soil-survey work is coordinated on a national basis so that similar soils are everywhere given the same names and descriptions in all States. At the same time, the State scientists contribute their detailed local experience. This cooperative basis makes it possible to have the benefits of both local and national experience and to develop a common nomenclature that fits the local conditions.

The Division of Soil Survey not only sees that soil types are accurately and uniformly defined and mapped but also cooperates with other divisions of the Bureau in coordinating the results of other plant and soil research with the findings regarding soil types and soil groups recognized in the system of classification. It is through the medium of soil classification and soil maps that much of the Bureau's work finds application to specific fields, farms, and rural communities.

Examples of Progress and Current Program:

Soil Management and Fertilization for Crop Production:

Feed crop production in the South: Cooperative work has been initiated in North Carolina to study cropping systems for increasing the yields of feed crops, corn and winter pasture. The Alabama Station is cooperating in similar studies and arrangements have been made to extend the studies into South Carolina in 1945. This work is of basic importance for obtaining an expansion in livestock production in the Southeast.

Nitrogen topdressings on temporary fall pastures have considerably increased protein production in the one season's test in North Carolina. A total of 83 pounds of protein per acre, equivalent to that in 200 pounds of cottonseed meal, was produced by topdressing Abruzzi rye with 20 pounds of nitrogen per acre as an average of three tests. In two other experiments the gain was 121 pounds of protein per acre from the use of 30 pounds of nitrogen. The large increases in protein resulted from an increased protein content of the forage and a larger yield of forage. This cover crop serves as pasture and prevents erosion during the winter and is then plowed under as a green manure crop for corn.

The rate of corn fertilization following the winter cover crop also is being studied in order to determine rotations, cropping systems, and fertilization practices best suited to livestock production in that region. In one test in Hoke County, North Carolina, yields of 19, 27, 47, 80, and 107 bushels of corn were produced with 0, 20, 40, 80, and 120 pounds of nitrogen per acre, respectively. No response was obtained to phosphate and potash. In another test using 100 pounds of nitrogen, a yield of 57 bushels of corn was obtained, but when a straw mulch was left on the surface and 100 pounds of nitrogen was used the yield was raised to 85 bushels per acre. These results indicate what may be expected when good management practices--hybrid corn, proper spacing of plants, proper tillage, cover crops, proper fertilization--are used in combination.

Improved fertilizer practice for potatoes: Continued fertilization of Maine potato soils at the prevailing heavy rates was found to have led to accumulations of available phosphates in such amount that omitting three-fourths of the phosphate from the fertilizer did not reduce yields. A possible saving of \$500,000 to \$700,000 in Maine is indicated. Cooperative studies of heavily fertilized potato soils in New York, New Jersey, North Carolina, and Maryland, are under way.

Work on war problems: Work on the stabilization of soils done in cooperation with Public Roads and U. S. Army Engineers was brought to a close. Many laboratory tests were made with various types of soil treated with different organic and inorganic materials to determine the effects on bearing power of the soil. Several materials with binding power gave promising results. A field test was made to determine the stabilization of soil material on a roadway subjected

to use by heavy Army trucks. Roadways given this treatment did not stand up under heavy army traffic but treatment for reducing dust on airfields, and other post-war uses was suggested.

A rapid semi-micro method was developed for determining the rubber present in plant materials. On adding acetone to a benzene solution of plant material an emulsion of rubber particles is formed. A scattering of light is produced by the emulsion and by measuring the intensity, the amount of rubber present is estimated. This method has been employed for routine examination of specimens of goldenrod and Russian dandelion. A confidential report was circulated to all rubber investigators describing the method.

A confidential investigation of gun-barrel gases was brought to a successful conclusion and the results reported to the National Defense Research Committee.

Special reports were prepared for war agencies on sources of supply and consumption demands of phosphate rock and phosphate fertilizers in the United States and in the various countries of the world, intended for determining lend-lease requirements and allocations and their relation to present and post-war food production.

Irrigation Practice, Drainage, and Salinity Control:

Fertilization increases yields of irrigated crops: Results from irrigated rotation and cultural experiments continue to show that no combination of crops will maintain high levels of productivity unless supplemental additions of plant nutrients, in the form of either manure or fertilizer or both, are made in the soil. In the early years of irrigation in the West, it was believed that if alfalfa and other legumes were grown in rotation with non-leguminous plants, soil fertility could be maintained. For a period of years, yields were maintained in such crop rotations. Gradually, however, yields began to decline, as the result of removing large quantities of minerals from the soil in the high yields of alfalfa and other crops. The addition of farm manure has made it possible to hold high yields at a high level, but in recent years there is increasing evidence that phosphorus additions are required also, if productivity is to be maintained. In rotations where manure is not used, there is evidence that yields can be maintained at high levels with applications of nitrogen and phosphorus fertilizers, but the use of both manure and fertilizers gives still better results. In the light of this information, the use of inorganic fertilizers in irrigated regions, contrary to earlier beliefs, is justified, and their more general use in these regions is expected.

Improved soil fertility reduces disease losses in sugar beets: In cooperative experiments with the Montana Experiment Station, black root of sugar beets was greatly reduced when soil fertility was improved with added fertilizers. Fusarium wilt also was found to be associated with nutritional deficiencies.

In a rotation where beets, small grains and alfalfa are grown without manure or fertilizers, beets showed 5-year averages as follows: Stand, 45 percent; seedling diseases, 66 percent; yield, 3 tons per acre. In a similar rotation, except that manure, phosphate, and nitrogen were applied liberally as needed to obtain maximum production, the 5-year averages were: Stand, 100 percent; maximum seedling diseases, 7 percent; yield, 18 tons per acre. Where manure only was applied in a similar cropping system the averages were: Stand, 97 percent; seedling diseases, 30 percent; yield, 13 tons per acre. Sugar beets in the maximum crop production rotation, as compared with other rotations, always have the lowest amounts of all diseases and the highest stands and yields.

Sweet clover vs. alfalfa in irrigated rotations: Irrigated soils in general are low in nitrogen. As a consequence, legumes have a very important place in irrigated crop rotations. Alfalfa is usually used in longer rotations where it provides hay for 2 to 4 or more years. In shorter rotations sweet clover is often planted with small grains and used the following year for pasture or a hay crop. The sweet clover is then followed by potatoes, beets, or corn. If this shorter rotation can be depended on to supply adequate nitrogen to the cash crops, it has the advantage of allowing more cash crops to be grown. At Scottsbluff, Nebraska, it has been found that yields of potatoes, beets, and corn following either pastured sweet clover or sweet clover used as green manure are almost as high as those following alfalfa. However, at Prosser, Washington, yields of potatoes, beets, and corn following sweet clover are actually depressed below the yields obtained in rotations without legumes. On the other hand, responses following alfalfa are very good and equal to those obtained from either alfalfa or sweet clover at Scottsbluff. Studies are in progress at Prosser to discover the reason for the depressing effect of sweet clover.

Dry-land Management Investigations:

Flowless fallow: Extensive experiments with implements that leave most of the crop residues on the surface have been conducted in the Great Plains by the Bureau, generally in cooperation with State Experiment Stations. In general, surface residues have not significantly increased or decreased yields, and where the presence of such residues does not introduce insect or disease problems, their desirability can be measured by the cost of cultivation and by the protection they afford against wind and water erosion. Results in the lighter rainfall portion of the Columbia River Basin are much the same as those in the Great Plains. In the higher rainfall area surface straw depresses yields, and an application of nitrate fertilizers is necessary to bring production up to the level of that on plowed land. As a 12-year average at Pendleton, Oregon, nitrogen fertilizers increased yields over the no-nitrogen treatments by 5 bushels of wheat per acre.

Sulfur increases pea yields: Experiments with fertilizers in growing canning peas at the Pendleton, Oregon, station have shown over several years that ammonium sulfate increases the percentage of fancy peas and delays the hardening period by as much as a week, which enables the grower to harvest a larger part of the crop as green peas. Preliminary results indicate that much of the benefit of the fertilizer is due to the sulfur, which can be purchased alone more cheaply than in either ammonium sulfate or land plaster. The use of sulfur applied as flowers of sulfur increased the yield of dry peas 430 pounds to the acre at the Pendleton station in 1943. An application of 50 pounds of sulfur to the acre is recommended and is being generally adopted by the many pea growers in this area.

Grass seeding on the Great Plains: The good seed habits of crested wheatgrass and its ability to compete successfully with weeds and other vegetation when sown by inexpensive methods in stubble or weed cover with a drill in the fall have resulted in its seeding on millions of acres in the northern Plains and in the Pacific Northwest since its introduction by the Department and its cooperative development at, and distribution from, dry-land stations some years ago. In the southern Plains native species such as buffalo grass, the gramas, sand lovegrass, little bluestem, and western wheatgrass, and the introduced weeping lovegrass are being used by ranchers on large acreages since their adaptation for such seedings was determined and a successful method for obtaining stands was developed in cooperative work at dry-land stations. Old sandy cropland in New Mexico seeded with a grass mixture (blue grama, sideoats grama, little blue stem, and san lovegrass) in 1941 by the stubble mulch method produced 1,130 pounds of hay in 1942 and 712 pounds in the very dry year 1943. This is at least as good as the very best native sod in the area.

Soil fertility of dry-land soils declining? Recent studies of soils from the crop rotation and cultural experiments at the Northern Great Plains Field Station at Mandan, North Dakota, show that under the cropping systems generally followed in the area, soil fertility is being depleted. The magnitude of the depletion is shown in the following data:

Change in Soil Fertility in 30 Years under
Various Systems of Cropping--Mandan, North Dakota

Cropping System	Change in	Change in
	Organic Carbon	Nitrogen
	%	%
Wheat		
Continuous	-21.5	-20.0
Alternate with fallow	-28.0	-26.0
Oats		
Continuous	-26.0	-22.0
Alternate with fallow	-37.5	-34.0
Barley		
Continuous	-17.0	-15.0
Alternate with fallow	-27.0	-25.0

Change in Soil Fertility in 30 Years under
Various Systems of Cropping--Mandan, North Dakota - Cont.

Cropping System	Change in	Change in
	Organic Carbon	Nitrogen
	%	%
Corn		
Continuous	-39.5	-37.0
Alternate with fallow	-44.0	-41.0
Corn, wheat, oats, rotation		
Without manure	-38.4	-35.0
With manure	-5.0	+2.0

In all cases, except where manure was used, soil fertility has declined appreciably. Alternate fallow with small grains has caused about 50 percent more depletion than growing small grains continuously. Corn has caused a depletion almost double that caused by wheat. This is due to the additional cultivation of the corn crop plus the fact that corn yields have been higher than wheat. Almost half of the original carbon and nitrogen have been lost from the soil where corn has been grown 30 years. The rotation of corn, wheat, and oats, without manure has depleted the carbon and nitrogen by more than one-third, but when manure was used every third year the fertility has been maintained. However, grain yields with manure have been almost identical to those without manure. Although water is still the limiting factor on this dry land soil the time evidently is approaching when yields may decline even in years of favorable rainfall unless systems of cropping are devised to maintain fertility.

Soil Classification for Crop Production:

Soil inspection and correlation: About 1,050 mapping projects of the Department and the States are being inspected and the soils classified. The inspection of these projects by scientists in the Soil Survey results in the conduct of the work so that it will most effectively fulfill the immediate needs for agricultural production and conservation as well as contribute to the standard soil survey of the country, basic to all agricultural programs dealing with rural land. Soil inspection and correlation on surveys made by the Soil Conservation Service is financed by an allotment of funds from that Agency.

Progress in making and publishing soil maps: Even though nearly all field scientists normally engaged in making new soil maps were occupied during the fiscal year 1944 with studies of the soil requirements and potential distribution of special war crops and food crops, substantial progress was made in developing vitally needed soil maps, mostly by personnel in cooperating State organizations. During the fiscal year 1945 all field work on regular soil surveys is being conducted by State soil survey organizations.

New soil survey maps and reports of 11 areas were issued during the fiscal year 1944. These include:

California:	Santa Cruz Area.
	Tracy Area
Idaho:	Blackfoot-Aberdeen Area
Indiana:	Vanderburgh Co.
Montana:	Upper Musselshell Area
New Hampshire:	Coos County
North Carolina:	Henderson Co.
North Dakota:	Billings Co.
Ohio:	Lucas Co.
Oklahoma:	Choctaw Co.
Texas:	Dimmit Co.

Soil data for war uses: Much assistance has been given war agencies, including the Army and Navy, regarding soil conditions in this and other countries in relation to food production, airport construction, camouflage, ground conditions, and land problems.

Fertilizer Materials and Improvement:

Ammonium nitrate fertilizer: The diversion of surplus ammonium nitrate from munition plants, as was pointed out last year, prevented a shortage of nitrogen for fertilizer purposes. While intensive investigations on the kind of treatment necessary to make this ammonium nitrate usable as a fertilizer resulted in avoiding a stringency in nitrogen supply during the 1943 and 1944 seasons, there were still to be solved many problems encountered only under conditions of actual use. Work on some of these problems was conducted in cooperation with the War Production Board.

By adopting methods of manufacture whereby ammonium nitrate was produced in granules or as large grained material, its physical condition appeared suitable for fertilizer use. However, many car loads of the early product arrived hard-caked in the bags. Other shipments were in moist or wet state, making distribution impossible. This necessitated further investigation of treatments, and bagging, shipping, and storage conditions required for maintaining the proper physical properties.

It has been found that operational factors in the manufacture of ammonium nitrate influence the condition of the product delivered to the fertilizer manufacturers. For example, bagging while still quite warm increases the tendency for granular ammonium nitrate to cake in the bag, since it is more plastic at elevated temperatures and the granules are then easily deformed under low pressure. The types of coating and of dusting powder influence the moisture absorption and the caking of ammonium nitrate. The bag in which it is shipped and stored probably exerts greatest influence on moisture absorption. Multiwall bags with one or two bituminous layers and sewed ends offer good protection against moisture penetration. If of the proper quality, this type of bag is most effective in preventing absorption of water and in maintaining the desired condition.

Ammonium nitrate is being employed in mixed fertilizers in both solid and solution forms to replace sodium nitrate and ammonium sulfate, and a relatively large portion of the nitrogen can be present in most

mixtures as ammonium nitrate without causing trouble due to moisture absorption or caking. It has also been used with success for separate application where previously sodium nitrate alone was acceptable.

The commercial ammonium nitrate contains 32.5 percent nitrogen, half ammonium-nitrogen, and half nitrate-nitrogen. A given quantity of ammonium nitrate is equivalent for crop use to a mixture of sulfate and sodium nitrate containing the same amounts of the two types of nitrogen in combination, this having been long recognized and verified by vegetative tests. Another phase of its use not yet fully explored involves fire and explosion hazards. On the basis of literature reviews, recommendations have been developed for the safe handling of ammonium nitrate as a fertilizer. Available information deals mostly with explosive hazards, and practically nothing is available on fire hazards of ammonium nitrate in mixed fertilizer. This subject is now being investigated.

The extension in use of ammonium nitrate has been rapid. The promptness with which the problems have been attacked and the confidence inspired in the public by the results of the investigations have made possible the quick assimilation by fertilizer consumers of an unfamiliar product. In 1942 about 1,000 tons of ammonium nitrate were used as fertilizer; for the fertilizer year 1943-44 about 300,000 tons were available and used satisfactorily.

Mineral phosphates for animal feeds: In normal times bone meal constitutes the principal source of nutritional phosphorus in feeds for animals and poultry. Wartime conditions have greatly curtailed this source of material. The War Food Administration accordingly requested assistance in locating new sources or in developing mineral sources of phosphate suitable for feed use. The shortage of bone meal, approximating 140,000 tons, necessitates the use of substitutes, but the prevalence of toxic quantities of fluorine in domestic phosphate rock and in many fertilizer grade phosphates, such as superphosphate and dicalcium phosphate, impelled a search for low fluorine phosphates that could be produced in considerable tonnage without affecting appreciably the phosphate supplies for other purposes. Superphosphate, on account of its high fluorine content, 1.2 to 3.9 percent, could not be recommended for direct use in animal feeding. Work in the Bureau showed, however, that a satisfactory product containing less than 0.1 percent of fluorine can be obtained by heating superphosphate at a temperature of 1850° Fahrenheit. By utilizing idle cement kilns it was possible to place the process in commercial operation in a very short time with only a small installation of new equipment. Approximately 40,000 tons of superphosphate defluorinated by this process were produced in the fiscal year 1944.

(g) Agricultural Engineering

Appropriation Act, 1945	\$353,639
First Supplemental Appropriation Act, 1945 (replacement of building and equipment destroyed by fire at Stoneville, Mississippi, laboratory)	+83,000
Proposed transfer in the 1946 estimates from "General administrative expenses"	+24,893
Total available, 1945	461,532
Budget estimate, 1946	528,000
Change for 1946:	
Overtime decrease	-45,952
Increase	+112,420
	<u>+66,468</u>

PROJECT STATEMENT

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
1. Farm mechanical equipment:	\$98,368:	\$148,590:	\$148,590:	-
2. Farm structures and related investigations	39,144:	47,100:	217,100:	+170,000 (1)
3. Mechanical processing of farm products	132,893:	213,980:	131,400:	-82,580 (2)
4. Utilization of electric power on farms	5,054:	5,910:	30,910:	+25,000 (3)
5. Overtime costs	36,819:	45,952:	-	-45,952
Unobligated balance	5,817:	-	-	-
Total available	318,095:	461,532:	528,000:	+66,468
Transferred to "Salaries and expenses, Office of Information, Department of Agriculture"	+200:	-	-	-
1943 balance available in 1944	-20,000:	-	-	-
Total estimate or appropriation (1944 and 1945 adjusted for comparability)	298,295:	461,532:	528,000:	

INCREASES OR DECREASES

The net increase of \$66,468 for 1946 consists of the \$45,952 decrease for overtime and the following:

- (1) An increase of \$170,000 to develop basic information needed for the design and construction of improved buildings for livestock, storage of crops, housing for farm families, and other farm purposes.

Objective: To aid farmers and builders in planning and building structures to meet farm needs and obtain maximum value from the large expenditures contemplated in immediate post-war farm construction.

The Problem and Its Significance: An expenditure for farm building construction of approximately \$1,300,000,000 a year for the immediate 10-year post-war period is reliably indicated by estimates of the Producers' Council, Inc., the leading organization of building material and equipment manufacturers in the United States. This compares with the Council's estimate of \$6,400,000,000 per year for urban residences. Presumably, the members of the Producers' Council are planning their post-war production on the basis of these estimates. This total layout of \$13,000,000,000 over a 10-year period for farm construction will be required to wipe out the effects of the depression and the war-induced lag in repair and replacement of farm buildings.

This problem cannot be met by simply restoring present farm buildings to their original condition. Industry, whenever building replacement is necessary, adapts its new construction to improved techniques and makes use of improved products available on the market. Agriculture should follow this efficient procedure when such a large capital replacement is contemplated. Without new information and proper guidance, farmers may realize only a small part of the potential benefits from this tremendous investment.

One of the essential objectives of farm building research is to determine the best housing conditions for livestock—the amount of space, winter and summer temperatures, ventilation, and other factors affecting efficient livestock health and production. All animals produce better under proper housing conditions. Take the matter of temperature. Sudden drops in temperature may lower milk production or egg production as much as 25 percent. The annual loss of one-third of all little pigs is due in considerable part to cold buildings. In buildings with poor ventilation moisture condenses on the walls and ceilings during cold weather, and where this prevails day after day, noticeable deterioration and eventual failure of the building occurs. Odors due to poor ventilation lower the quality of milk. The proposed research is designed to develop means for overcoming these and other unfavorable conditions.

Likewise, similar information is needed on buildings for storing crops. Profit disappears when a crop is lost or damaged in storage.

At present, one-third of all farm labor is performed in and around the buildings. Industry has developed a "time and motion" technique for studying time and methods for doing certain jobs. These studies have shown innumerable places where the work can be speeded up by the elimination of lost motion, reducing the cost of production. Such studies could be used to advantage in improving the arrangement of farm buildings as well as of the farmstead, thereby reducing farm labor requirements.

Labor saving machinery and new farm practices are changing building requirements. Where grass silage is used, haymow size may be reduced by two-thirds. Chopped hay and baled hay require only half the storage space needed for loose hay, and are easier to handle. Combine harvesters do away with large threshing crews and the need for big rooms to feed them. Tractors have made horse barns obsolete on many farms, but have increased the need for good machinery storages and farm shops. Portable elevators make it possible to use second-story space to advantage.

Year to year changes in farming to meet market demands require that buildings be adaptable to more than one kind of livestock and, if necessary, for crop storage.

The war has developed large scale fabrication of standardized buildings, some of which can no doubt be adapted to farm use. There are also new materials that have certain advantages for easy erection. Some of these will prove very useful on farms while others will not be satisfactory because of relatively short life due to inability to resist high humidity or mechanical damage from livestock. In studying use of these new materials for farm purposes, all information available from the National Bureau of Standards and the Forest Products Laboratory will be utilized.

The farm house requires a study of its own. The average life of the farm house is about 65 years. During this time the family regardless of its size and age of the members has to fit into this building. It is a home, a workshop for partial processing of farm products, and the business center of the farmstead. The city man can engage the services of a trained architect if his house is of sufficient cost. Also a great deal of moderate and low-cost city home building is done in connection with real estate developments which provide architectural services. Such services are not available to the farmers and very few architects are qualified to appraise farm family needs. The same situation is more pronounced in the case of livestock buildings and grain storage structures. The work in farmhouses will be carried on jointly with the Bureau of Human Nutrition and Home Economics to obtain the benefits of their studies in livability.

Plan of Work: The research program will be carried out in cooperation with other bureaus of the Agricultural Research Administration and with State experiment stations, involving work in various areas to take account of varying climatic factors. Full cooperation with the Bureau of Human Nutrition and Home Economics will be maintained relative to the planning of farm houses. Information will be made available to farmers as rapidly as possible through the Extension Service, and farm building plans prepared embodying the new developments will be distributed to farmers through the Cooperative Farm Building Plan Service. The amount requested is equivalent to only about 3 cents per farm, a very small amount compared to the probable post-war building investment per farm and the benefits likely to accrue from the proposed studies.

- (2) A decrease of \$82,580 (\$83,000 less \$420 overtime) for a non-recurring item provided in the First Supplemental Appropriation Act, 1945, to replace a building and equipment destroyed by fire at the United States Cotton Ginning Laboratory, Stoneville, Mississippi.
- (3) An increase of \$25,000 to develop and adapt electrical equipment and devices for income-producing uses on the farm.

Objective: To develop and increase income-producing uses for electricity on the farm, including economical curing of hay and tobacco, and refrigeration of food products such as fruits, vegetables, dairy and poultry products, and meat.

The Problem and Its Significance: Electricity has contributed much to farm living but little to farm income as yet. To help pay for the convenience of electricity and to obtain load volume that will permit lower rates for power, the development of income-producing uses is greatly needed. Numerous opportunities exist for the development of such uses, as for example, hay curing, tobacco curing, quick freezing and refrigeration of perishable food products for market and home consumption, water supply for home and livestock, farm food processing, food storage and preservation, electrically operated conveyors and elevators, small automatic feed grinders, electric sorting and grading devices, light, heat, and health rays, plant disease and insect control, and many others. However, this request contemplates emphasis on work to develop and adapt electrical equipment and devices for the economical mow-curing of hay, flue curing of tobacco on the farm, and the individual farm refrigeration of food products such as fruit, vegetables, dairy and poultry products and meats.

Generally in the humid areas throughout the country, particularly in the South, large annual losses occur from the improper curing of hay. Inability to cut hay at the proper time because of weather conditions, or failure to obtain proper curing, result in serious deterioration in nutritional value, particularly in protein, mineral, and vitamin content. It has been demonstrated that cutting at the proper stage of development, with prompt drying at proper temperatures without unnecessary exposure to rain or sun, gives a product of maximum nutritional value.

Cereals and grasses cut at the proper stage and promptly dried under the right conditions give a feed for poultry and livestock high in essential growth-promoting substances which are present in these plants in the young stages in such large quantities. Alfalfa, clovers, vetches, etc., all rich in proteins, vitamins, and minerals, when so treated likewise produce feeds superior to those resulting from average methods of preparation dependent on the vagaries of weather. The development of a feasible economical electrical drying unit, suitable for a single farm or group of farms, can play an important role in improving farm livestock rations, likewise reducing the cash outlays for protein concentrates and other supplementary feeds now necessary.

The curing of bright leaf tobacco is a process of drying the tobacco with various temperatures and air humidities in the several stages of the process, but the equipment and methods in common use are the same that have been used for a hundred years. These methods require constant attention, day and night during the curing period, while the determination of the end of the various stages, as well as of temperature and humidity, are by rule-of-thumb. Consequently, a large part of every tobacco crop is of low grade and price because of imperfect curing. It is believed that electric appliances can be adapted to this curing process to automatically control the temperature and humidity at pre-determined levels and make the necessary changes when the various stages have been completed. This will result in tobacco of uniform quality and a marked reduction in labor requirements.

Enormous quantities of fresh foodstuffs are lost or sold to disadvantage each year because the farmer lacks the drying and refrigerating equipment needed to preserve his fruits, vegetables, meats, and dairy products for his own use or for marketing as a high quality product in an orderly manner. Simple economical devices for farm use can do much to improve not only the farmer's economic position, but also the general average of the rural diet.

Rural electrification has made great forward strides in recent years because it can do so much to aid the farmer in his business, and in addition is useful in providing cultural and educational advantages, in removing much housekeeping drudgery, and in providing better lighting and better sanitation. As a source of power, it has many peculiar advantages. It is safe, it is immediately ready to start or stop, and is available to almost any desired quantity. Many farmers are unable to secure the advantages of electricity, however, because few income-producing uses for electric power have been developed. For example, a survey made in 1942 of one highly electrified county, where electricity had been available to farmers for many years, showed that only 7 percent of the farms served made any use of electric power on farm operations. It is obvious that income-earning uses must be found, if small income farmers are to obtain the full advantages of electric service, and it is equally true that with increased consumption, rates will be lower and costs will be reduced.

Plan of Work: The work will be carried on in cooperation with the Rural Electrification Administration, the State experiment Stations, the Bureau of Human Nutrition and Home Economics, forage and tobacco specialists, and others. Full advantage will be taken of existing shops and laboratories and other facilities available for work on the engineering phases of this project.

CHANGES IN LANGUAGE

The estimates include the following proposed changes in the language of this item (new language underscored, deleted matter enclosed with brackets):

Agricultural engineering [investigations]: For investigations [, experiments, and demonstrations] involving the application of engineering principles to agriculture [; for investigating and reporting upon the different kinds of], including farm power and [appliances; upon farm domestic] equipment, rural water supply and [sewage disposal, upon the design and construction of] sanitation, and rural electrification; farm buildings and their appurtenances and [of] buildings for processing and storing farm products, and the preparation and distribution of building plans and specifications; [upon farm power and mechanical farm equipment and rural electrification, upon the] cotton ginning, and other engineering problems relating to the production, processing, transportation, and storage of [perishable and other] agricultural products; [and upon the engineering problems involved in adapting physical characteristics of farm land to the use of modern farm machinery; for investigations of cotton ginning under the Act approved April 19, 1930 (7 U. S. C. 424, 425); for giving expert advice and assistance in agricultural and chemical engineering; for collating, reporting, and illustrating the results of investigations and preparing, publishing, and distributing bulletins, plans, and reports, \$353,639, of which (notwithstanding the above limitation upon buildings) not to exceed \$10,000 may be expended for the construction of a building at the Houma (Louisiana) station] \$528,000.

The language changes in the first paragraph of this item are proposed for simplicity and brevity, and include the deletion of much of the language because the necessary authorizations are provided in the proposed language for the preamble. The changes also include a restatement of the authorization for "the preparation and distribution of building plans and specifications," in order to clarify the authority for preparing, on a reimbursable basis, plans and specifications for laboratory and similar buildings for other agencies. Authorization provided for the fiscal year 1945 for construction of a laboratory and machine shop building at Houma, Louisiana, is deleted.

WORK UNDER THIS APPROPRIATION

Objective: The broad objectives of the agricultural engineering work are to increase efficiency in farming operations, reduce labor requirements, improve primary processing methods, provide for more economical and efficient placement and use of fertilizers, and develop safe storage facilities for field crops and vegetables. More

specific objectives are: (a) to improve existing and develop new types of farm machinery for producing staple and special war crops; (b) to develop improved storages for staple and other crops; (c) to assist in providing needed wartime supplies of important fibers through the development of improved methods of cotton ginning, fiber flax processing, and sansevieria processing; and (d) to extend the uses of electricity on farms.

The Problem and its Significance: Agricultural engineering in its broad sense is the application of engineering principles to agriculture. Engineering principles, however, have not been applied to agriculture to the extent they have in industry. The opportunities are great. Improved farm equipment--the farmers' production tools--and improved farm buildings, where the meat and other animal food products are developed and partially processed, should increase the efficiency and economy of many farm operations and permit the farmer to enjoy, as the urban dweller does, the benefits of engineering progress.

Agricultural engineering research, in collaboration with soil and plant research, is directed toward the designing of more efficient farm implements for improving practices in crop production, harvesting, handling and storing. Contributions of agricultural engineering research of this type aided materially in the record production of farm crops during the last few years. The work done thus far indicates still greater possibilities of improving crop production at reduced costs by the further application of engineering principles. Similarly, agricultural engineering research, in collaboration with animal husbandry and dairy industry research, is directed toward the improvement of animal production practices. Farmers have been building, or are having built for them, animal shelters and other farm structures based on ideas and opinions conceived principally in urban construction. Little information is available on the fundamental requirements of housed animals; that is, the required amount of air, desired temperature, humidity, and freshness. These factors affect animal efficiency as they do that of humans. Unsatisfactory conditions in animal shelters are paid for in increased feed, reduced weight, or lowered milk production. Exact determination of these fundamental requirements will provide a basis for designing, constructing, and equipping farm buildings best suited to livestock production. Similar problems pertain to dwellings and their equipment as well as to farm building arrangement.

Agriculture in wartime is called on for the maximum production of food crops with a minimum of labor and a scarcity of machines and equipment. Special crops are required to provide new sources of materials and crops heretofore grown in small volume must be expanded to produce the tremendous quantities required. Provision must be made for the safe storage of field crops and vegetables so they can be held without unnecessary losses and can be marketed in

an orderly manner to meet military and civilian needs. Many new and small-volume crops require production methods and procedures before their permanent and potential value can be ascertained. These include the fibers--flax, hemp, ramie, and sansevieria.

In addition, the value of some of our newer crops, such as peanuts and soybeans, has been demonstrated in wartime to the extent that expanded production may continue after the war. This should be accompanied by fundamental engineering research or mechanized production.

The extension of rural power lines emphasizes the need for research to provide the farm electric user with profit-producing applications. These include applications in poultry and hog production, light for illumination and health, automatic grinders and feed processors, water heaters, devices to improve animal health, non-freezing water faucets, hay hoists, manure-handling equipment, and other devices to simplify work, reduce labor, and increase production.

General Plan: Work is conducted at the following four Government-owned laboratories: Auburn, Alabama, for research in farm machinery; Stoneville, Mississippi, for developing improved methods of ginning cotton; Beltsville, Maryland, for fertilizer placement machinery; and Ames, Iowa, for the study of problems in the storage of wheat, corn, sorghum, and Irish potatoes. Other laboratories and machine shops are located in buildings owned by cooperators, including the Flax Processing Laboratory at Corvallis, Oregon; the project on mechanical control of insects and pests at Toledo, Ohio; the project on potato storage at Fort Collins, Colorado; and the project on sweetpotato-production machinery at Ellisville, Mississippi. Almost the entire research program is carried on in cooperation with State and other agencies.

Examples of Progress and Current Program:

Farm Mechanical Equipment:

A sprayer for corn borer control. An experimental self-propelled high clearance sprayer has been developed for use in corn borer control which is not only effective but also economical in operation. Borer damage in 1943 to early sweet corn in the Toledo, Ohio, area caused total losses on untreated fields. In sprayed plots the borer population was reduced 93 - 97 percent as compared to the unsprayed checks where the infestation was as high as 50 borers per plant.

Proper fertilizer placement increases crop yields. Under conditions in western Washington deep placement of fertilizer directly under the seed gave highest yields of carrots, spinach and Swiss chard. Increased yields per acre were over 4,000 pounds of carrots, 136 pounds of spinach seed, 3,300 pounds of cannery spinach and 6,800 pounds of Swiss chard.

With peanuts in Virginia, tests indicated that highest yields are obtained by placing the fertilizer in a band at each side of the row, whereas placement immediately under the seed materially reduced the yields.

In New York State the highest yields of tomatoes were obtained when one-half of the fertilizer was placed in a deep band in each furrow at the time of plowing and the other half placed in a band at each side of the row at the time of setting the plants. The same system gave the best results with cabbage, except that two-thirds of the fertilizer was applied at the bottom of the plowed furrow. Yields for different placements of the fertilizers differed as much as two tons of cabbage per acre, showing the economic importance of proper placement.

Based either wholly or partly on the results of our fertilizer placement research, new distributing machinery has been developed for growers. Several manufacturers during the past year placed on the market for the first time plow attachments for placing fertilizer in a band on the bottom of the plowed furrow, as a result of this research.

Improved peanut production machinery: A commercial adaptation of a single-row, one-horse planter, developed by the Bureau is now on the market. This planter is particularly suited for use on small farms for planting peanuts and corn. It opens the seed bed, puts down the fertilizer and plants the seed in one operation, saving 50 percent of the time required for performing these operations in the usual manner.

An experimental peanut harvester has been built which will dig, shake, and windrow two rows of vines at a rate of approximately three acres per hour. This machine reduces the labor requirement to one-half man hour per acre whereas twenty to twenty-five man hours per acre were required with the one mule equipment and hand methods commonly used.

A farm sized sheller has been developed to reduce the difficulty of obtaining high quality shelled peanuts for seed. Many present commercial shellers split a large number of the nuts and unless such shelled seed are planted promptly the germination is very poor. It has been necessary, generally, to shell the peanuts by hand, a slow and tedious operation. The new farm sized sheller is simple, effective, low in cost and is capable of shelling as many peanuts in one hour as one man can shell by hand in 300 hours.

Tung nut huller shows promise: A huller that will hull tung nuts as gathered (no available commercial machinery will do this job) is being tested. Indications are that it will do an effective job and be simple to operate. Use of this machine will make possible reducing the quantity of material to be stored and transported to the mill by over 50 percent.

Work also is being conducted on a gathering arrangement that will pick tung nuts from the ground without hand labor. Use of this machine with the huller attachment will enable gathering and hulling the nuts ready for storage with no hand labor other than the machine operator, thus reducing labor requirements by 75 - 90 percent.

Farm Structures and Related Investigations:

In cooperation with the War Food Administration and five of the State Agricultural Colleges, designs were prepared for Irish potato and sweetpotato storage houses requiring the use of a minimum amount of critical materials to take care of the large potato crop of 1943. These standard plans were used as the basis of construction or remodeling of storages for about 7,000,000 bushels of Irish potatoes and 3,000,000 bushels of sweetpotatoes.

One of the principal difficulties encountered in grain storage in the Southern part of the grain belt is the activity of insects in the summer months. It has been found that if metal grain bins are painted white, the temperature of winter-cooled grain within the bins will be five to ten degrees lower during the summer than in similar unpainted bins. This is very important since there is little insect activity in a bin unless its temperature is above 70 degrees. In white bins this temperature is not reached until later in the summer and the length of time during which the temperature is above 70 degrees is much shorter than in unpainted bins. In Central Kansas insect activity was so reduced by the lower temperatures due to white paint on bins of 1,000 to 2,740 bushel capacity that it was not necessary to fumigate wheat which had been cooled by standing in the bins during the preceding winter. This puts the grain grower in Kansas in about the same class, as regards insect damage, as if he were located 300 miles farther north.

Studies of the storage of ear corn again have emphasized that the most common cause of spoilage is the cribbing of corn with more than 20 percent moisture content in the kernels; and that most of the damage occurs during periods of warm weather. If wet corn must be cribbed, cribbing should be delayed until the weather is cool. Free circulation of air is needed to dry corn, and for this reason narrow cribs and full exposure to winds are recommended. Recent tests have shown the importance of also having the corn free from husks, silks, or shelled corn, since the presence of these materials in quantities commonly found in farm cribs reduced the flow of air to less than one-third the amount passing through cribs of clean corn.

Because the introduction of machines for field-shelling corn, instead of husking it, is being delayed by lack of suitable facilities for drying the shelled corn, a study is being made of this problem. Data on the rates of air flow through different depths of corn and on the rates of drying with air of different temperatures and relative humidities have been obtained. Several structures have been tested but none has as yet proved satisfactory.

Mechanical Processing of Farm Products:

Fiber flax processing machinery: The harvesting and processing of fiber flax requires more labor than most other similar field crops. In an effort to reduce the labor requirements, work is being conducted on an experimental fiber flax combine which pulls, deseed, binds and threshes the seed of the crop in one operation in the field. When the combine is used the deseeding operation at the mill is eliminated and the straw is ready for the retting tanks when hauled to the mill. Indications are that use of this combine will result in a saving in labor cost of at least two dollars per ton of pulled flax.

Cotton ginning investigations: The Cotton Ginning Laboratory has been working for several years in perfecting equipment to press cotton at the gin to a standard density of about 22 pounds per cubic foot to take the place of the ordinary gin press which works only at a low density of 11 pounds per cubic foot. Last year an experimental press was installed in a commercial gin in the Mississippi Delta with further satisfactory results. During the past year a similar press has been installed for extended trials in a commercial gin in the Western Texas area where the cotton is quite different from that grown farther East. The operation of the press was entirely satisfactory, and it was found that 130 bales of standard density can be loaded in an ordinary freight car which holds only 80 of the low density bales. This means a considerable saving in storage space and in freight rates and speeds up the progress of the cotton from the gin to the textile mill.

For many years the more serious complaints received from textile mills and export buyers of American cottons were with regard to the excessive number of bales which were injured by air cuts while being compressed. It was originally thought that these cuts were due to air under pressure being forced out of the lint by the compress, but it has been determined that they were due to unequal density in the bales, due in a large part to the action of the "dogs" used to hold the lint in place during pressing at the gin. A public service patent has been secured on a plate dog mechanism for use in ginning presses which entirely eliminates cutting of the bale when it is compressed and at the same time makes for a more uniform distribution of the lint within the bale. Over 300 bales have been pressed in a commercial gin using this new device and none of these bales showed any air cuts when the cotton was compressed to standard density. Prior to the installation of this new mechanism more than 50 percent of the bales pressed at this gin were cut during compression. This device is simple, easily installed and, due to the public patent, the right to manufacture or use it is available to all.

Sansevieria fiber processing: For many years sansevieria, a plant producing a hard fiber, has been grown in many tropical regions but without much success because no decortivating machine could process it economically. Since the plant grows wild in southern Florida, and because sansevieria fiber is recognized as one of the best substitutes for manila hemp, a project was set up to determine the feasibility of producing and processing it to relieve present shortages of cordage fibers. An experimental machine has been developed which has already demonstrated that sansevieria can be decorticated on a commercial scale. The machine handles over 800 pounds of leaves per hour and reclaims over 90 percent of the fiber contained in the leaves. Cooperative tests to determine the best varieties of plants for fiber production, the proper fertilizer treatment and the economics of commercial production are being continued.

Utilization of electric power on farms: Statistics indicate that in this country during 1943 about 239,000,000 dozen eggs were lost because of spoilage somewhere between the nest and the consumer. Undoubtedly the greater part of this loss occurs on the farm before the eggs are put in the regular marketing channels. Although considerable research has been conducted in maintaining egg quality, no data exist to show whether or not there is a critical temperature humidity range for maximum keeping qualities. Using the cooling effect of water evaporated from saturated curtains, two egg coolers have been designed, which in use indicate that such an inexpensive homemade cooler, when augmented by an electric fan, maintains egg qualities so well that one-third more eggs were graded "extras" than was the case under normal storage conditions.

(h) Cereal Crops and Diseases

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Field crops", as shown in the table on the second page of the explanatory notes for this bureau.

(i) Cotton and other Fiber Crops and Diseases

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Field crops", as shown in the table on the second page of the explanatory notes for this bureau.

(j) Drug and Related Plants

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Fruit, vegetable, and specialty crops", as shown in the table on the second page of the explanatory notes for this bureau.

(k) Dry-land Agriculture

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Field crops", "Fruit, vegetable, and specialty crops", and "Soils, fertilizers, and irrigation", as shown in the table on the second page of the explanatory notes for this bureau.

(l) Forage Crops and Diseases

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Field crops", as shown in the table on the second page of the explanatory notes for this bureau.

(m) Fruit and Vegetable Crops and Diseases

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Fruit, vegetable, and specialty crops", as shown in the table on the second page of the explanatory notes for this bureau.

(n) Irrigation Agriculture

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Fruit, vegetable, and specialty crops" and "Soils, fertilizers, and irrigation", as shown in the table on the second page of the explanatory notes for this bureau.

(o) Plant Exploration, Introduction, and Surveys

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Field crops" and "Fruit, vegetable, and specialty crops," as shown in the table on the second page of the explanatory notes for this bureau.

(p) Soil and Fertilizer Investigations

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Soils, fertilizers, and irrigation", as shown in the table on the second page of the explanatory notes for this bureau.

(q) Soil Survey

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Soils, fertilizers, and irrigation," as shown in the table on the second page of the explanatory notes for this bureau.

(r) Sugar-plant Investigations

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Field crops", as shown in the table on the second page of the explanatory notes for this bureau.

(s) Tobacco Investigations

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Field crops", as shown in the table on the second page of the explanatory notes for this bureau.

(t) Plant Industry Experiment Farm

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Salaries and expenses, Office of Administrator, Agricultural Research Administration", as shown in the table on the second page of the explanatory notes for this bureau.

(u) National Arboretum

Appropriation Act, 1945	\$31,500
Budget estimate, 1946	<u>26,800</u>
Change for 1946:	
Overtime decrease	-4,700
No other change	<u>-4,700</u>

PROJECT STATEMENT

Project	: 1944	: 1945	: 1946	: Increase or
	: (estimated)	: (estimated)	: (estimated)	: decrease
1. National Arboretum:	:	:	:	:
Maintenance and operation:	:	:	:	:
of Arboretum	\$35,021:	\$26,800:	\$26,800:	- -
2. Overtime costs	5,399:	4,700:	- -:	-\$4,700 (1)
Unobligated balance	2,480:	- -:	- -:	- -
Total estimate or	:	:	:	:
appropriation	42,900:	31,500:	26,800:	-4,700

DECREASE

(1) Decrease of \$4,700 due to elimination from the 1946 estimates of the estimated fiscal year 1945 overtime cost.

CHANGES IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

National Arboretum: For the maintenance and development of the National Arboretum established under the provisions of the Act entitled "An Act authorizing the Secretary of Agriculture to establish a National Arboretum, and for other purposes", approved March 4, 1927 (20 U. S. C. 191-194), [employment of persons and means in the city of Washington and elsewhere, and] including travel expenses of [employees and] the advisory council, [\$31,500] \$26,800, of which not to exceed \$2,500 may be expended [by contract or otherwise for the services of consulting landscape architects without reference to the Classification Act of 1923, as amended, or civil-service rules] for employment pursuant to the second sentence of section 706(a) of the Act of September 21, 1944 (Public Law 425).

The first two changes in language delete the following authorizations: (1) For employment in the city of Washington, since such employment is authorized in the preamble and need not be repeated; and (2) for travel expenses of employees, since specific authorization for this purpose is not necessary.

The third change revises the language relating to employment of consulting landscape architects as authority therefor is now provided in the Department of Agriculture Organic Act of 1944, approved September 21, 1944 (Public Law 425).

WORK UNDER THIS APPROPRIATION

Objective: To establish and maintain a National Arboretum with a diversity of tree and other plant life for research and educational uses, in conformity with the authorizing Act (Public No. 799-69th Congress).

The Problem and Its Significance: The work at the National Arboretum has been primarily on a maintenance basis during the war. The essential problem at the Arboretum is the development of a living collection of all woody plants that can be grown in the District of Columbia to serve as a source of plant materials and educational information concerning plant life for students and scientists throughout the country. With a great storehouse of plant materials from all corners of the world established at the Arboretum, breeders of trees, shrubs, and flowers will have an opportunity to cross native species with those from foreign lands for the development of improved strains adapted for special purposes such as for city parks, forests, boulevards, and streets.

It is expected to make the facilities of the Arboretum available to scientists all over the world, and cooperation is contemplated with foresters, botanists, horticulturists, and other scientists in the improvement of trees, shrubs, and other plants. The Arboretum thus becomes an educational institution which at the same time will provide an abundance of growing plant material for scientific purposes.

In order to be most useful for purposes of research and education, the Arboretum is being planned and developed with a view to: (a) taking the fullest possible advantage of all environmental factors at the site selected, such as soil type, slope, exposure, and drainage; (b) the grouping in the most suitable locations of all the adapted plants of many genera or species; (c) making them available for general observation and detailed study; and (d) preserving for reference, identification, and classification, herbarium specimens of all plant materials likely to be of value in this country.

It is necessary to give all possible care to existing collections of plant material in the nursery and to that which has been placed in permanent location. This requires work to prevent damage from erosion or poor drainage, cutting of brush and weeds, cultivating, maintaining soil through cover cropping and fertilizing, and related management practices to prevent loss of past work.

General Plan: The National Arboretum is located in the District of Columbia bounded approximately by M and R Streets, N. E., Bladensburg Road, and the Anacostia River. An advisory council, appointed by the Secretary of Agriculture in accordance with the Act of March 4, 1927 (20 U. S. C. 191-194), assists in planning the development of the Arboretum. Plant collections generally are established in nurseries at the Arboretum prior to being placed in permanent plantings. Plant materials are obtained by purchase, gift, and by transfer from the bureau's Division of Plant Exploration and Introduction, a source of exotic plants from foreign countries.

Current Program:

Work at the National Arboretum continues on a maintenance basis for the duration, using the skeleton force for the best possible maintenance of the nurseries, of areas previously developed, and of areas currently developed to receive material which must be removed from nurseries because of size. Work also includes necessary care of the drainage and road systems.

The trees transplanted from the nursery in recent years provide the basic materials for the conifer collection, as well as a more complete planting of holly and magnolia.

Planning studies continue for the development of the road system, and of specific areas to provide for permanent plantings of material already in the nurseries.

(v) Special Research Fund, Department of Agriculture
(Allotment to Bureau of Plant Industry, Soils, and
Agricultural Engineering)

This budget schedule covers obligations under an allotment for work conducted under Special Research Projects and Regional Laboratories.

(w) Salaries and Expenses, Soil Conservation Service
(Allotment to Bureau of Plant Industry, Soils, and
Agricultural Engineering)

This budget schedule shows obligations under an allotment for inspection and correlation of surveys made in connection with the program of the Soil Conservation Service.

All soil survey inspection and correlation work in the Department of Agriculture was consolidated in the then Bureau of Plant Industry by an order of the Secretary, effective September 1, 1942. The consolidation was made with a view to achieving more effective administration and conduct of the work so that all soil classification and mapping done by the Department will fulfill the immediate needs of agricultural conservation and adjustment programs as well as contribute to the basic soil survey of the whole country.

The surveys of the Soil Conservation Service are designed primarily to meet needs in developing conservation plans for individual farms. In order that the information obtained in these surveys can best meet these needs and at the same time contribute effectively to the basic soil survey program of the Department and cooperating State Agricultural Experiment Stations, the surveys must be inspected and correlated to insure that the soils are properly identified and accurately mapped and classified. The classification of soils on a uniform nationwide basis is essential for effective application of results of plant and soil research, including research on erosion control, to specific fields, farms, and rural communities.

Under procedures developed in agreement with the Soil Conservation Service, inspectors of the Soil Survey paid from this allotment examine each area where surveys are planned to determine what soil types are present, and prepare a legend to be followed in mapping these soils. This constitutes the first inspection of the area, after which one or more progress inspections and a final field inspection are made to determine whether the surveyors have properly identified the soils and have shown them accurately on the maps. The results are then checked by the regional inspector with results of other surveys in the region, and any necessary corrections made to insure uniformity in classification and nomenclature of soils throughout the region. About 1,040 mapping projects of the Soil Conservation Service are being inspected and the soils classified.

The work involves close cooperation with the State Experiment Stations in the improvement of soil type definition and classification in the light of research findings.

(x) Emergency Fund for the President, National Defense
(Transfer to Bureau of Plant Industry, Soils, and
Agricultural Engineering)

This budget schedule covers obligations for the fiscal years 1944 and 1945 under a transfer for emergency plant disease prevention.

(y) Rubber Investigations

This budget schedule covers final obligations during the fiscal year 1944 under the unobligated balance of an appropriation made by the Second Deficiency Appropriation Act, 1940, for surveys and investigations directed toward plantation rubber production in the Western Hemisphere.

Continuation of the program for development of rubber production in the Western Hemisphere is provided for by transfer from the Department of State appropriation "Cooperation With the American Republics." A transfer of \$292,209 to the Department for this purpose will be made for the fiscal year 1945, and the Budget estimates for 1946 contemplate the transfer of \$310,000 for this work in the fiscal year 1946. The item is considered by the Subcommittee on Appropriations for State, Commerce, and Justice, as a part of the program for cooperation with the American Republics being conducted under the general supervision of the Secretary of State.

(z) Emergency Rubber Project, Department of Agriculture
(Allotment to Bureau of Plant Industry, Soils, and
Agricultural Engineering)

This budget schedule covers obligations under an allotment for production, culture, and handling investigations on guayule and other emergency rubber crops (1946 allotment estimate is limited to guayule).

(aa) Working Funds (Bureau of Plant Industry, Soils,
and Agricultural Engineering)

This budget schedule covers obligations under advances, pursuant to Section 601 of the Economy Act of June 30, 1932, for services performed for various agencies as indicated in the following statement of obligations under supplemental funds.

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS
[1944 and 1945 figures include overtime costs]

Item	Obligations, 1944	Estimated obligations, 1945	Estimated obligations, 1946
<u>Special Research Fund, Department of Agriculture:</u>			
Special research projects	\$121,195:	\$134,175:	\$117,445
Special research laboratories in major agricultural regions	393,630:	330,091:	288,950
Total, Special Research Fund	424,825:	464,266:	406,395
<u>Soil Conservation Service (Allotment to BPIS&AE): Inspection and correlation of soil surveys made by the Soil Conservation Service</u>	170,961:	195,568:	173,300
<u>Emergency Fund for the President, National Defense: For emergency plant disease prevention</u>	176,768:	248,300:	- -
<u>Rubber Investigations: Surveys and investigations relating to rubber production in Western Hemisphere</u>	18,880:	- -	- -
<u>Emergency Rubber Project, Department of Agriculture: Investigations directed toward the production of rubber from guayule and other rubber-bearing plants</u>	628,560:	314,010:	90,000
<u>Working Funds (Bureau of Plant Industry, Soils and Agricultural Engineering)</u>			
<u>Advances from:</u>			
<u>War Production Board:</u>			
Investigations in food compression and packaging of dehydrated compressed food products	31,248:	3,974:	- -
Investigations on milkweed as a source of fiber	12,667:	- -	- -
Investigations on ammonium nitrate as a fertilizer	9,410:	5,590:	- -
Total, War Production Board	53,225:	9,564:	- -
<u>Commodity Credit Corporation: Development of methods of properly caring for grain in storage</u>	12,855:	5,525:	- -
<u>State Department: Cooperation with the Chinese Government in the study of agricultural problems</u>	6,371:	7,129:	- -

Item	Obligations, 1944	Estimated obligations, 1945	Estimated obligations, 1946
Working Funds (Bureau of Plant Industry, Soils and Agricultural Engineering)			
Advances from: Cont'd			
War Department: Investigations on effect of fungi decay on Ordnance material, and methods for control ..	244:	756:	--
Foreign Economic Administration: Con- tinuance of cinchona bark development: program in Colombia and Peru as a source of quinine	3,573:	--:	--
Total, Working Funds	76,268:	22,974:	--
Cooperation with American Republics (Transfer from State): 1/			
Investigation directed toward planta- tion rubber production in the Western Hemisphere	272,500:	292,209:	310,000
TOTAL, OBLIGATIONS UNDER SUPPLEMENTAL FUNDS:	1,768,762:	1,537,327:	979,695

1/ The budget schedule relating to this project appears in the State Department chapter of the Budget, page 596.

PASSENGER-CARRYING VEHICLES

The estimate for purchase of passenger-carrying vehicles for the Bureau of Plant Industry, Soils, and Agricultural Engineering contemplates the replacement of 23 vehicles (approximately 13 percent of the present number in use) at an estimated net cost of \$18,900; and the purchase of 6 additional vehicles at an estimated cost of \$6,000 for use on activities for which increases are requested in the 1946 estimates.

The average mileage on the cars to be replaced was 62,710 on June 30, 1944, and it is estimated that these cars will have been driven an average of 71,400 miles on July 1, 1945. In normal times, experience has shown it to be more economical to trade in 20 to 25 percent of the cars each year, so as to avoid exceeding an average age of about four years and performance of 40,000 to 50,000 miles. On July 1, 1945, 74 percent of the Bureau's cars will be 5 years old, or older, and will have been driven an estimated average of 49,000 miles.

Cars operated by the Bureau are being conserved and used only for essential investigations on crop, soil, and agricultural engineering problems in localities where other means of transportation are inadequate or nonexistent. If procurement of the new vehicles should prove impracticable, the funds estimated for this purpose would be needed for additional costs of keeping the old cars in operation and of performing essential travel by other means.

PENALTY MAIL

Section 2, Public Law 364, 78th Congress
(Allotment to Bureau of Plant Industry,
Soils, and Agricultural Engineering)

	<u>Category 1</u>	<u>Category 2</u>	<u>Total</u>
1945	\$2,200	\$5,967	\$8,167
1946	2,500	6,600	9,100
Change	+300	+633	+933

Category 1 consists of the mailing of farmers' bulletins and other publications furnished in response to specific requests for information which results from the research work of this Bureau on the development of improved disease-resistant crop varieties; methods of soil management and cultural and fertilizer practices maintaining soil fertility and giving maximum production on a permanent basis; control of plant diseases and weeds; agricultural engineering, etc.

Category 2 consists of administrative and operating correspondence with field personnel located throughout the United States and with the State experiment stations and other agencies cooperating with the Bureau in its research programs, and mailing of vouchers, payrolls, and other operating documents. In addition, there is a considerable exchange of small parcels of seed and other plant materials with cooperators and employees of the Bureau.

The increase of \$933 for 1946 will be required to meet the cost of increased mailings in connection with additional cooperative relationships and correspondence with State agricultural experiment stations and other agencies, and for the dissemination of additional information on the research of the Bureau, resulting from an enlarged program of work for which there are increases totaling approximately \$300,000 in the estimates for 1946.

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BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

The simplification of the appropriation structure for the Agricultural Research Administration proposed in the 1946 Budget estimates includes a consolidation of subappropriation items for the Bureau of Entomology and Plant Quarantine, Salaries and expenses, reducing the number of such items from 23 to 3. The following table shows a complete distribution of the 1945 subappropriation amounts on the basis of the proposed new sub-appropriation setup:

Distribution of 1945 Fiscal Year Appropriations under the
Consolidations Proposed in the 1946 Budget Estimates

Existing Subappropriations, 1945		Proposed Appropriation Items, 1946			
Title	Total Amount	Insect	Insect and	Foreign	
		investiga- tions	plant disease control	plant quaran- tines	
General administrative expenses	\$160,920	\$65,370	\$72,550	\$23,000	
Foreign plant quarantines	b/899,700			899,700	
Fruit insects	457,230	457,230	-	-	
Forest insects	a/227,000	227,000	-	-	
Truck crop and garden insects	326,340	326,340	-	-	
Cereal and forage insects	403,370	403,370	-	-	
Cotton insects	163,730	163,730	-	-	
Bee culture	91,950	91,950	-	-	
Insects affecting man and animals	175,000	175,000	-	-	
Insect pest survey and identi- fication	145,000	145,000	-	-	
Foreign parasites	25,000	25,000	-	-	
Control investigations	76,485	76,485	-	-	
Insecticide and fungicide in- vestigations	130,520	130,520	-	-	
Japanese beetle control	400,000	13,500	386,500	-	
Sweetpotato weevil control	78,670	-	78,670	-	
Mexican fruitfly control	169,820	-	169,820	-	
Gypsy and brown-tail moth con- trol	409,320	-	409,320	-	
Dutch elm disease eradication	300,000	13,000	287,000	-	
Phony peach and peach mosaic eradication	99,340	-	99,340	-	
Barberry eradication	283,470	-	283,470	-	
Pink bollworm and Thurberia weevil control	738,960	-	738,960	-	
Transit inspection	45,900	-	45,900	-	
Certification of exports	34,480	-	-	34,480	
Total	5,842,205	2,313,495	2,571,530	957,180	

a/ Includes \$25,000 appropriated in First Supplemental Appropriation Act, 1945.

b/ Includes \$102,000 appropriated in First Supplemental Appropriation Act, 1945.

The Budget schedules and project statements of the Explanatory Notes for the proposed new appropriation items continue to show substantially the same detailed project information as heretofore, so that the information as to insect pests and specific crops continue to be available for the review of Congress.

(a) Salaries and Expenses - Preamble

CHANGES IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

For [necessary] expenses [connected with] , independently or in cooperation with public or private agencies, including individuals, corporations, or foreign governments, necessary for investigations, experiments, [and] demonstrations and surveys for the promotion of economic entomology, for investigating and ascertaining the best means of destroying insects and related pests injurious to agriculture, for [investigating and] importing useful and beneficial insects and bacterial, fungal, and other diseases of insects and related pests, for investigating and ascertaining the best means of destroying insects affecting man and animals, [to enable the Secretary to carry] and the best ways of utilizing beneficial insects, for carrying into effect the provisions of the Plant Quarantine Act of August 20, 1912, as amended (7 U. S. C. [146,147,] 151-167 [,281,282]), [to conduct other activities hereinafter authorized, and for] the Honey Bee Act (7 U. S. C. 281-282), the Insect Pest Act (7 U. S. C. 141-144), the Mexican Border Act (7 U. S. C. 149) and the Department of Agriculture Organic Act of 1944 (Public Law 425), authorizing the eradication, control, and prevention of spread of injurious insects and plant pests [, independently or in cooperation with other branches of the Federal Government, States, counties, municipalities, corporations, agencies, individuals, or with foreign governments]; including the purchase of, not to exceed seven airplanes, and [the employment of necessary persons and means in the District of Columbia and elsewhere, of which] not to exceed [\$633,886 may be expended] \$544,493 for personal services in the District of Columbia, [rent, construction, alteration, or repair of necessary buildings outside the District of Columbia: Provided, That, unless otherwise specifically provided, the cost for the construction or alteration of any building shall not exceed \$1,500 and the total amount expended for such construction in any one year shall not exceed \$7,000,] as follows:

The foregoing language has been revised in connection with the proposed rearrangement of the appropriation structure of the Bureau, which combines the present 23 subappropriation items under the appropriation "Salaries and Expenses, Bureau of Entomology and Plant Quarantine" into 3 subappropriation items. The purpose is to reduce the length of the present rather unwieldy subappropriation structure by combining related activities within a single item. This is considered highly desirable in the interests of facilitating operations.

Specific changes in the preamble are explained as follows:

1. The position of the clause relating to cooperation has been changed by placing it at the beginning of the item. A slight change has been made in the phraseology which does not change its meaning.
2. In an endeavor to have the preamble present clearly the various activities conducted thereunder, language has been included to describe activities not heretofore referred to in the preamble but carried on under the various subappropriations. These activities are (a) surveys, (b) investigations on utilization of beneficial insects, and (c) activities under the Honeybee Act, the Insect Pest Act, the Mexican Border Act, and the Department of Agriculture Organic Act of 1944, approved September 21, 1944.
3. A clause has been included covering the purchase of aircraft, for which specific authority will be required under provisions proposed in Section 203 of the Independent Offices Appropriation Bill as recommended in the 1946 Budget. Preliminary tests have shown that certain types of airplanes offer great promise as effective distributors of insecticides, and the procurement of planes to advance this experimental work is contemplated.
4. Elimination of the language with regard to construction, alteration, and repair of buildings, since a general provision therefor is included, for the Agricultural Research Administration as a whole, in the appropriation language for the Office of the Administrator.

(b) General Administrative Expenses

This subitem of appropriation is being transferred to and consolidated with the items "Insect investigations", "Insect and plant disease control", and "Foreign plant quarantines", as shown in the table on the first page of the Explanatory Notes for this Bureau.

(c) Insect Investigations

Appropriation Act, 1945, under above title	- -
Proposed transfers in 1946 estimates from:	
General administrative expenses	+\$65,370
Japanese beetle control	+13,500
Dutch elm disease control	+13,000
Fruit insects	+457,230
Forest insects (including \$25,000 contained in First Supplemental Appropriation Act, 1945, for research on the spruce budworm)	+227,000
Truck crop and garden insects	+326,340
Cereal and forage insects	+403,370
Cotton insects	+163,730
Bee culture	+91,950
Insects affecting man and animals	+175,000
Insect-pest survey and identification	+145,000
Foreign parasites	25,000
Control investigations	+76,485
Insecticide and fungicide investigations	+130,520
Total available, 1945	2,313,495
Budget estimate, 1946	2,047,000
Change for 1946:	
Overtime decrease	-293,355
Increase	+26,860
	<u>-266,495</u>

PROJECT STATEMENT

[Note: Amounts in parenthesis opposite numerically identified projects are totals of the alphabetically designated subprojects which immediately follow]

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
1. Fruit insects	:(386,146):	(412,000):	(412,000):	- -
(a) Deciduous fruit insects	: 182,700 :	194,500 :	194,500 :	- -
(b) Citrus and other subtropical fruit insects ..	: 39,000 :	44,700 :	44,700 :	- -
(c) Fruitflies which are potential pests in Continental United States ..	: 62,900 :	65,100 :	65,100 :	- -
(d) Japanese beetle investigations	: 101,546 :	107,700 :	107,700 :	- -
2. Forest insects	:(165,586):	(216,940):	(193,800):	(-23,140)
(a) Insects attacking mature timber	: 21,600 :	21,700 :	21,700 :	- -
(b) Insects attacking second growth timber ..	: 42,100 :	42,400 :	42,400 :	- -
(c) Insects attacking forest products	: 5,800 :	5,900 :	5,900 :	- -
(d) Termites	: 17,100 :	17,200 :	17,200 :	- -

PROJECT STATEMENT - Continued

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
(e) Insect vectors of forest tree diseases.	26,500	26,700	26,700	- -
(f) Surveys and advice to land-managing agencies	52,486	52,800	52,800	- -
(g) Spruce budworm	- -	50,240	27,100	-23,140 (1)
3. Truck crop and garden insects	(277,917)	(289,300)	(289,300)	- -
(a) Truck crop insects	228,217	236,300	236,300	- -
(b) Tobacco insects	49,700	53,000	53,000	- -
4. Cereal and forage insects	(352,104)	(358,100)	(358,100)	- -
(a) Cereal and forage insects	325,804	330,900	330,900	- -
(b) Sugarcane insects	26,300	27,200	27,200	- -
5. Cotton insects	(133,636)	(143,300)	(143,300)	- -
(a) Boll weevil	44,436	46,600	46,600	- -
(b) Pink bollworm investigations	27,300	28,900	28,900	- -
(c) Bollworm	10,700	11,300	11,300	- -
(d) Plant bugs affecting irrigated cotton.	14,300	15,600	15,600	- -
(e) Cotton fleahopper and related insects..	11,100	11,800	11,800	- -
(f) Cotton aphids ...	20,300	22,500	22,500	- -
(g) Various cotton insects	5,500	6,600	6,600	- -
6. Bee culture	79,104	82,000	82,000	- -
7. Insects affecting man and animals	(160,550)	(160,300)	(160,300)	- -
(a) Insects affecting man and animals	138,650	136,600	136,600	- -
(b) Household insects	21,900	23,700	23,700	- -
8. Insect pest survey and identification	(131,745)	(128,300)	(128,300)	- -
(a) Insect pest survey	6,900	7,000	7,000	- -
(b) Identification and classification of insects	124,845	121,300	121,300	- -
9. Foreign parasites ...	27,732	30,500	30,500	- -
10. Control investigations	71,675	74,100	124,100	+50,000 (2)
11. Insecticide and fungicide investigations ..	(123,257)	(125,300)	(125,300)	- -
(a) Chemical investigations on insecticides.	123,257	125,300	125,300	- -
12. Overtime costs	283,743	293,355	- -	-293,355
Unobligated balance	50,782	- -	- -	- -
Total estimate or appropriation (1944 and 1945 adjusted for comparability).....	2,243,977	2,313,495	2,047,000	-266,495

INCREASES OR DECREASES

The net decrease of \$266,495 in this item for 1946 consists of the \$293,355 decrease for overtime, and the following:

(1) A net decrease of \$23,140 under the project "Forest Insects (Spruce budworm)". In the First Supplemental Appropriation Act, 1945, approved December 23, 1944, an increase of \$25,000 was provided in order to intensify research to develop methods of controlling the spruce budworm, a very serious threat to the pulpwood timber stands of New England and certain other areas, particularly in the Lake States, and to the forests of Colorado. This amount was inserted in the course of Congressional action on the First Supplemental Appropriation Bill. The 1946 estimates do not provide for its continuance.

(2) An increase of \$50,000 on the project "Control Investigations".

Objective: To intensify research on the insecticide DDT.....

The Problem and its Significance: The results of the experimental work with insecticides containing DDT have been shown that this chemical is highly toxic to a wide variety of injurious insects. However, its toxicity differs with various insects and for some important pests it has not proven effective. It has also been demonstrated to be toxic to honey bees and to certain beneficial insects which has resulted in damaging secondary increases in such pests as aphids and mites even though the primary pest is controlled. Nevertheless, for the control of many kinds of injurious insects, it appears to be the most promising insecticidal chemical yet tested. It has unique properties acting as both contact and stomach poison. It remains toxic for long periods after application and only small quantities are required to kill species tolerant to larger amounts of other insecticides.

The experimental work that has been done is preliminary in nature, limited in amount, and for the most part confined to laboratory and small scale tests, which have been made on many kinds of crops and on most kinds of domestic animals, including poultry. The chemical has been formulated into insecticides applied as sprays, dusts, and aerosols. Its chemical and physical properties have been studied, but further investigation is necessary particularly as to formulation and as to deterioration by carriers and in the soil. Most of this research has been designed to develop control for specific insects and DDT insecticides have been used in comparison with other materials to determine its value for the control of these pests. These investigations are of a continuing nature until a fully satisfactory and effective control has been developed for use under all conditions, irrespective of whether DDT proves satisfactory or whether other materials must be used.

It is important that the experimentations be rapidly expanded to larger scale tests so that recommendations for grower use may be made at the earliest possible time, particularly where there is no other effective insecticide or where the known effective materials are in short supply due to the war.

Plan of Work: Preliminary research on DDT has been carried on and will continue to be conducted under the various projects. Where this preliminary work suggests that DDT insecticide will be particularly useful in the control of important insect pests, more extensive experimentation will be carried out. This will be done on areas considerably larger than the plots ordinarily used. Studies also will be made to determine the effect of general application on beneficial insects and on the pests they ordinarily hold in check. It is impossible to indicate the specific pests on which work will be conducted since it is not known just what leads may be developed during the remainder of the current fiscal year and the fiscal year 1946. It is probable, however, that two of the insects against which intensive work will be done with DDT insecticides are the codling moth and the pink bollworm.

The additional funds would be used in varying amounts where needed to intensify and expand the investigations conducted by the operating units concerned with the study of various pests. While the increase is included in the project "Control Investigations", it is intended that it will be available for use where such use would appear to be most advantageous to the accomplishment of the purpose for which the funds are provided. The Bureau of Plant Industry, Soils, and Agricultural Engineering is proposing to investigate the effects of DDT insecticide on plant growth, its compatibility with fungicides and its removal as a spray residue. The activities of the two bureaus will be properly correlated.

CHANGES IN LANGUAGE

The estimates propose the following language for this item:

Insect investigations: For the investigation of insects affecting fruits, grapes, nuts, trees, shrubs, forests and forest products, truck and garden crops, cereal, forage and range crops, cotton, tobacco, sugar plants, ornamental and other plants and agricultural products, household possessions, and man and animals; for bee culture and apiary management; for classifying, identifying and collecting information to determine the distribution and abundance of insects; for investigations in connection with introduction of natural enemies of injurious insects and related pests and for the exchange with other countries of useful and beneficial insects and other arthropods; for developing methods, equipment, and apparatus to aid in enforcing plant quarantines and in the eradication and control of insect pests and plant diseases; and for investigations of insecticides and fungicides, including methods of their manufacture and use and the effects of their application, \$2,047,000.

This item represents a consolidation of the items now carried for Fruit Insects, Forest Insects, Truck Crop and Garden Insects, Cereal and Forage Insects, Cotton Insects, Bee Culture, Insects Affecting Man and Animals, Insect Pest Survey and Identification, Foreign Parasites, Control Investigations, and Insecticide and Fungicide Investigations, together with funds for work applicable to these investigations now carried on under the item for Japanese Beetle Control, Dutch Elm Disease Control and a pro.rata part of the item for General Administrative Expenses.

The appropriation language recommended for "Insect Investigations" and the language recommended for the preamble are intended to provide the same authorizations and provisions for the research work involved as were provided by the 1945 Agricultural Appropriation Act.

WORK UNDER THIS APPROPRIATION

- Objectives: (1) To develop means whereby the growers of fruits, nuts, truck and garden crops, cereal, forage and range crops, cotton, tobacco, sugar plants and other agricultural products, can control insect pests more effectively or more economically, thus increasing the net returns from their operations and insuring the armed forces and the consuming public an ample supply of high-quality agricultural products;
- (2) To devise the most effective and economical means of preventing or controlling insect damage to forest and shade trees, forest products and shrubs;
- (3) To reduce losses from bee diseases, to promote better methods of apiary management for honey and wax production and for pollination and to provide for the use of superior strains of bees;
- (4) To develop control measures for those insects which transmit disease, annoy man, and attack livestock;
- (5) To devise the most effective and economical means of preventing or controlling insect damage to stored agricultural products, foods and fabrics;
- (6) To identify insects and allied organisms for the quarantine, control and research activities of the Bureau of Entomology and Plant Quarantine and other Federal and State agencies, farmers, pest control operators, and other private individuals of the United States, as well as for foreign institutions; and to collect, maintain, and furnish information as to the presence and abundance of insect pests;
- (7) To develop methods and apparatus for freeing commodities of pests under plant quarantine regulations so that they can move freely and safely in commerce; and to improve the chemical materials now employed in controlling insects, to develop new and better chemical materials, and to devise improved apparatus and methods for their application.

The Problem and its Significance: The problems encountered and the importance of solving them are discussed in the following paragraphs which are numbered to correspond with the objectives stated in the preceding section.

(1) Unfortunately all crops are subject to serious attack by insect pests. Losses due to these attacks vary with the crop and the season but the average annual loss from this source is high in spite of the available knowledge about insect control. These losses are due in part to failure to apply known methods thoroughly and timely, in part to the imperfect control measures available for many pests and to their cost. For example, including the cost of control measures, codling moth still exacts a toll of \$31,000,000 per year and some growers spend \$50 to \$60 per acre for control and still suffer losses. Corn earworm causes an average annual loss of \$79,000,000 to corn alone and in addition does serious damage to tomatoes and cotton. Probably the most reliable figures on insect losses over a period of years for any crop are those for cotton accumulated by the Bureau of Agricultural Economics. These indicate an average reduction from full yield due to insects of 13.1% per year for the period 1923-1943. The monetary loss figured on average farm prices during this period excluding the cost of the control applied varied from \$74,000,000 in 1931 to \$769,000,000 in 1923. Truck crops are especially subject to attack by a great variety of pests and annual losses are high. Losses of this type represent not only a severe financial burden to producers but also constitute a grave handicap to agricultural production in the war effort, to production to feed and clothe our population and to meet world demand in the post war period.

(2) Insects affecting forests and forest products are estimated to cause losses of more than \$100,000,000 annually. This destruction is particularly serious because of the greatly increased demands for lumber and other forest products used to meet war demands. This makes it particularly essential to protect the reserve supply of standing timber and the large quantities which have been cut for lumber and other purposes. It is also important to be in position to advise forest managing agencies, wood using industries, and those responsible for war-time construction activities, all of which have called for assistance and advice in applying control measures.

(3) Beekeeping is practiced in every state of the United States. There are more than 5,000,000 colonies representing an investment of \$55,000,000 with an annual production of about 200,000,000 pounds of honey, 5,000,000 pounds of beeswax, and \$500,000 worth of live bees for shipping into honey-producing areas. This represents an important commercial investment which should be protected by the best advice and service possible to the beekeeper.

It is even more important, however, to promote apiculture because of its relationship to the pollination of agricultural crops. Field studies indicate that honeybees perform at least 80% of the pollination which is essential to the production of almonds, apples, pears, plums, cherries, small fruits, melons, cucumbers, vegetable seeds, cotton, clover and alfalfa seed. It is also of importance in the

maintenance of pastures and ranges. When the values of these crops are considered, it becomes apparent that the encouragement of bee-keeping has an importance in the field of agricultural production far beyond the value of the wax and honey produced.

(4) The part played by insects in the transmission of disease to man and animals in the United States and the losses attributable to direct attack on farm animals is so important as to make it imperative that the habits and life history of these insects be clearly understood so that effective control measures can be developed. Production of beef, mutton, poultry, Mohair, wool, hides and dairy products is greatly affected by the depredations of many insect pests such as screwworms, biting flies, cattle grubs and lice. Horse raising and farming operations are also adversely affected by insects such as horse bots, stable flies and buffalo gnats. Malaria has always had a considerable incidence and fatality and in certain states the loss of work time and operating efficiency resulting from this disease is extremely high. It seems inevitable that troops returning to the United States from malaria infested areas will add to the problems of control of such diseases as malaria, dengue, and filariasis, all of which are carried by species of mosquitoes now within the United States.

(5) The insect problem in relation to agricultural products by no means ceases with the harvesting of crops. Tremendous damage has been done by insects to stored fruits, tobacco, grain, and fabrics. It is estimated, for example, that grain and flour weevils and moths have damaged stored grains and cereal products to the extent of more than \$360,000,000 annually. It is important to give every possible assistance to farmers, millers, warehouse operators, and others in protecting these products not only to prevent the loss of money values involved but also, particularly under present conditions, to avoid the interference to military operations due to deteriorated supplies of food products, uniform cloth, etc.

(6) There are many hundreds of thousands of different kinds of insects. Numerous species within many given groups resemble each other so closely as to appear identical but frequently have such different habits as to require different kinds of control or regulation. The exact identification of insects is therefore fundamental to research, control, and regulatory activities as well as to the farmer who must know the identity of an insect before proper control measures can be applied. Identification of many species can be made only by experts from specimens especially prepared for study and in many cases only after extended research. It is, of course, fundamental that there be adequate and up-to-date information as to the distribution of various insects throughout the United States. This is essential not only to intelligent control efforts but also to the economical and effective use of our present restricted supply of insecticides.

(7) War-time conditions have shut off the supply of certain standard insecticidal materials and at the same time have created a large demand for certain insecticides for the protection of agricultural crops

and also to safe-guard groups from disease-carrying insects. It is imperative, therefore, that new and effective insecticides be developed and that every effort be made to devise apparatus and methods which will make it possible to apply new insecticidal materials to the best advantage and to increase the effectiveness of those already in use. Also to meet war needs, it is essential that the restriction of movement of commercial commodities under quarantine regulations be held to an absolute minimum. This may best be accomplished by continued development of fumigation or other methods of treatment to allow the commodities to move freely without injury to themselves or the danger of spreading the pest involved.

General Plan: The research work carried on under this appropriation is under the direct supervision of appropriate subject-matter Divisions, as follows: Fruit Insects, Fruit Fly Investigations, Truck Crop and Garden Insects, Cereal and Forage Insects, Cotton Insects, Foreign Parasite Introduction, Forest Insects, Bee Culture, Insects Affecting Man and Animals, Insect Pest Survey and Information, Insect Identification, Control Investigations, and Insecticide and Fungicide Investigations. All of these Divisions have their administrative headquarters in Washington or at the Agricultural Research Center at Beltsville, Maryland, except Fruit Fly Investigations. However, with the exception of the work on insect identification, the research is done at field stations situated throughout the United States in localities where the work can be carried on to the best advantage against the particular pests involved. There are approximately 120 such stations distributed throughout the United States. The work program is so coordinated as to provide for cooperation between two or more Divisions, when advantageous. Much of the research is also cooperative with other Bureaus and with the appropriate State Agricultural Experiment Stations or other State agencies.

Examples of Progress and Current Program: The following discussion indicates under the various financial projects the present trend of work under the respective programs and outlines briefly some of the recent accomplishments:

1. Fruit insects:

Deciduous fruit insects: The new organic insecticide, DDT, gave remarkable control of the codling moth in preliminary field tests carried on at Vincennes, Indiana in 1943. Three applications of 3 pounds of a 50:50 DDT-pyrophyllite mixture per 100 gallons without supplements, beginning late in July, stopped completely a heavy worm attack for the remainder of the season. Even where the DDT was used at half that strength, the results were better than with a standard lead arsenate program. In some field experiments, the DDT permitted large increases in the population of European red mites, apparently by killing or repelling certain ladybird beetles that prey on the mites. Considerable defoliation occurred on trees of the Grimes variety sprayed with DDT, but this defoliation may have been caused by the abundant mites. No defoliation occurred

on trees of the Winesap variety. The results through June, 1944 at several field laboratories have confirmed those of the preliminary tests, but further work is necessary not only on the effectiveness and methods of use against the codling moth but also on the effect of the material on fruit pollinating insects as well as on other beneficial insects, including both parasites and predators of insect pests. Also, although preliminary work indicates that DDT is of relatively low toxicity to human beings and animals, an evaluation of its possible accumulative effect has not been completed.

Further experiments at Yakima, Washington, resulted in the improvement of the method of using xanthone. Although it was found that 2 pounds to 100 gallons gave better results than 3 pounds of lead arsenate in controlling the codling moth, and also reduced the population of the Pacific mite, further work on the method of its use is necessary in order to simplify it.

In the Northwest, field tests of a dinitro-o-cresol spray to destroy hibernating codling moth worms, made on a larger scale than previously, killed 86 to 94 percent of the worms, and reduced the worm infestation 25 to 50 percent. It has been shown that the cost is reasonable and that there is a great reduction in labor over the requirements for scraping and banding.

At Vincennes, Indiana the repeated evening spraying of apple trees with small quantities of nicotine sulphate solution poisoned many of the moths present, and reduced the number of codling moth injuries by 42 percent.

Although phenothiazine has given a high degree of kill of the codling moth in the Northwest, no way has yet been developed to prevent its adverse effect on the color of red apples, and work with it has been largely discontinued for the present.

Nicotine bentonite gives better control of the codling moth than lead arsenate in the more southern apple-growing areas of the Middle West, and in those areas during 1943 and 1944 there has been a widespread change to nicotine bentonite, stimulated in part by higher fruit prices. This swing would have gone further if shortages of nicotine had not developed during 1944. Some lots of Mississippi bentonite have been found to contain abrasive material which has caused excessive wear on spray machinery parts. The usefulness of bentonite from various sources requires further study.

In the Hudson Valley codling moth control obtained with 8 applications of dust containing 20 percent lead arsenate fortified with 10 to 20 percent processed nicotine bentonite, 2 percent of a 100-viscosity oil, and in one instance 20 percent of lime, compared favorably with that obtained by the growers' 4-application spray schedule in a moderate infestation. The dust schedules tested cost \$1.57 to \$2.73 for each tree for the spray schedules, but were more economical of labor.

Although the control of codling moth is being gradually improved and the value of new materials is being established, factors of comparative cost and relative efficiency under varying conditions require additional detailed study.

Comstock mealybug. The principal center of activity of the Comstock mealybug, and the most severe fruit injury, occurred in the Winchester areas of northern Virginia. A number of new infestations were reported from Augusta County, Virginia and from Delaware, New Jersey, and Connecticut. Injury to fruit in Virginia and West Virginia orchards averaged 47 percent in 1943 as compared with 68 percent the previous year, due to the reduced population of the mealybug resulting largely from high parasitization during 1942, and early spring freezes in 1943. Satisfactory initial control of the mealybug has apparently resulted in infested orchards of southern Ohio and northern New Jersey, following a rapid increase in parasites introduced by the Bureau. The introduced parasite species were also recovered in fair abundance in central Virginia during 1943 despite the extreme scarcity of mealybugs since the fall of 1942. Mealybug populations are again building up in some of the older infested orchards of that area but there is an excellent possibility that the introduced parasites, which are already established, may be able to prevent resurgence of the pest in this area. An active program of parasite colonization in cooperation with state agencies is under way and will be continued. An unidentified fungus disease of mealybugs which reduced mealybug population in 1942, was very light in Virginia in 1943. In Ohio, however, this organism killed 42 percent of the first and 19 percent of the second brood adult female mealybugs, while only a trace of disease was recorded from New Jersey and Delaware and none at all from Connecticut.

Parlatoria chinensis. Laboratory and field tests at St. Louis, Missouri indicated that effective commercial control of the recently introduced scale insect, Parlatoria chinensis (Marl.) can be obtained with an emulsion of a 100 or higher viscosity oil, applied during the late dormant or delayed dormant periods. Paraffin base oils were effective at 3 percent whereas those having a naphthene base required 4 percent. During the summer, at times when the scales present were mostly immature, a 2 percent concentration of an 80 or higher viscosity paraffin base oil was effective.

Plum curculio. Two applications in 1943 of ground sprays consisting of either dichloroethyl ether or dichloroethyl formal at Fort Valley, Georgia proved to be just as effective against the plum curculio as the regular schedule of lead arsenate sprays applied on the fruit. An improved curculio jarring sheet which holds the curculios in a bag in the center, developed at the same laboratory, caught an average of 2.5 beetles per tree as compared with 1.3 beetles per tree caught with the old sheets. These methods require wider tests in order to determine their usefulness under practical orchard conditions.

Oriental fruit moth. A big increase in the production of Macrocentrus ancyliivorus, the most important parasite of the oriental fruit moth, has resulted from rearing the parasites on the potato tuber worm. Use of this new host, previously considered but not tested, was made possible by the finding of the tuber worm near Moorestown, New Jersey, where it had formerly been believed to be absent. In addition to studies on mass rearing, colonies of the parasite are being released, in cooperation with State agencies, in areas where it does not occur.

The oriental fruit moth parasite Macrocentrus ancyliivorus was found to overwinter abundantly in the strawberry leaf roller larvae infesting wild blackberries and other related plants which occur in large numbers in the vicinity of most peach orchards in southern New Jersey. This finding opens up the possibility of effective parasite colonization late in the season, and indicates that fall cage-breeding of parasites on the strawberry leaf roller might be more successful with some of these newly found plant hosts than with the cultivated strawberry previously used.

In continued cooperative work carried on with the Ohio Agricultural Experiment Station at Wooster, Ohio, further experimental releases of Macrocentrus ancyliivorus against second brood larvae of the oriental fruit moth at the rate of one female per tree produced no noticeable reduction in visible injury to the fruit and no significant increase in parasitization could be noted in the orchards in which parasites were liberated. The number of parasites released per tree in these experiments was only about 1/5 the number usually recommended for control purposes.

Insect vectors of virus diseases. The investigations to determine the possible insect vectors of the phony peach disease, peach mosaic, and other virus diseases, have been continued. Phony peach disease transmission tests were made with 169 lots of insects, making a total of 617 tests since this phase of the project was started in 1940. The majority of this year's tests involved species whose distribution and behavior suggest special consideration as vector-suspects. Final readings were made on 81 tests initiated in 1940. All results were negative but in the case of only one insect species were there enough tests involved to warrant considering the results conclusive.

A total of 559 peach mosaic transmission tests were carried out in established test plots in southern California and in a greenhouse near Riverside, California; at Brownwood, Texas; and in a small new test plot at Espanola, New Mexico; to take advantage of the conditions of rapid disease spread discovered there. These tests involved 42 species of insects, and represented all of the families which are known to include plant virus vectors. Readings from experiments carried on before 1943 were all negative.

Transmission tests with the Western "X" disease were also performed in test plots maintained by cooperating plant pathologists at Wenatchee, Washington and Salt Lake City, Utah. A total of 221 experiments were initiated, involving approximately 50 species of insects.

Nut tree insects. Further experiments by the Albany, Georgia laboratory in cultural control of the hickory shuck worm by destruction of the larvae in infested nut drops through the use of a disk tiller has given favorable results. For the Schley and Stuart varieties, respectively, the percentage of nuts infested was reduced about one-half by the use of the disk tiller and as a result of the treatment the yield of nuts was more than doubled.

A survey in northern Louisiana showed that larvae of a new species of curculio caused injury to nutbearing terminals of pecan trees in each of the 7 orchards examined. Nearly all of the nutbearing shoots on the varieties Stuart, Succoss, and Pabst were destroyed by the larvae of this insect in orchards near Coushatta, Louisiana. Further attention will be given to this new injurious insect enemy of pecans.

The study of the susceptibility of the different varieties of filbert to attack by the filbert worm and the filbert weevil in the Northwest gave results that show the commercial varieties Daviana and Hall's Giant are the most susceptible, followed by Barcelona, DuChilly, and Red Aveline.

The sanitation experiments in filbert orchards in Oregon, designed to show if the periodic removal and destruction of the nuts dropping from the trees during the preharvest season would reduce the insect damage, indicated in 1943 that approximately 95 percent of the worms in the premature drops were destroyed when the drops were removed at weekly intervals.

Insects attacking dried fruit. Three types of experimental dried-fruit packages, known as the Reynolds bag, Bemis bag, and "J" package, were tested at the Fresno, California laboratory for insect-proofness by exposure to the Indian-meal moth, the saw-toothed grain beetle, and the confused flour beetle. In all exposures, insects gained entrance to dried fruit in a box protected by the Reynolds bag, which apparently is not sufficiently tough to hold up when in contact with the wood of the outside case.

Measurements were made of the width of crevice which can be entered by newly hatched larvae of certain species of dried-fruit insects. The narrowest opening penetrated by the Indian-meal moth was .12 mm.; by the saw-toothed grain beetle, .16 mm.; and by the confused flour beetle, .12 mm.

Work in 1943 with the effect of low temperatures on stored-fruit insects indicated that 36 days of exposure at about 32° or 38° F. were completely fatal to saw-toothed grain beetles. Test lots of beetles placed in cold storage in February were more resistant to both temperatures than were lots exposed beginning in warmer weather. At about 32°, all raisin moth larvae were killed after 177 days and all Indian-meal moth larvae after 112 days, but the latter species probably will be found to succumb after shorter exposures. At about 38° all raisin moth larvae were dead after 305 days and all Indian-meal moth larvae after 151 days. In all, 205 lots of 200 insects each were used in the tests.

Cherry fruitflies. Surveys have shown the cherry fruitflies, chiefly Rhagoletis cingulata (Loew) and to a lesser extent R. fausta (O.S.), to occur on the West Coast in the Transition and Canadian Life Zones from the Sequoia National Forest north, wherever the preferred wild host, Prunus emarginata, occurs. South of that point this host has not fruited for several years. In California these life zones occur at elevations mostly about 5,000 feet, where cultivated cherries are not grown. In Oregon cultivated cherries are grown in the Transition Zone, and in parts of that State they are extensively infested.

Grape berry moth. At Sandusky, Ohio, dosage tests of lead arsenate for the control of the grape berry moth were applied with two types of stickers or spreaders, namely rosin fish-oil soap and mineral oil emulsion of the summer type. Although no differences among lead-arsenate concentrations were shown, it was found that the summer oil (2-1/2 quarts per 100 gallons) was superior as a sticker to rosin fish-oil soap (2 pounds per 100 gallons). Commercial nicotine bentonite (containing 14 percent nicotine) was definitely inferior to Bordeaux oil sprays when both types of materials were used as late sprays following early arsenical - Bordeaux sprays in a split schedule. The commercial nicotine bentonite gave a final berry moth damage of 29 percent as compared to 14 percent for the Bordeaux-oil sprays.

Citrus and other subtropical fruit insects: In studies of the California red scale, carried on at Whittier, California, considerable work was done in the field with tent fabrics differing in gas-retention properties. Fabrics treated with certain plastic products were found to retain 3 to 4 times as much gas to the end of a 45-minute exposure period as the standard fumigation tents now in use. Correlated with the gas-retention is a higher mortality, or the possibility of an equal kill with lower initial dosages. With the blowers and gas-tight tents it has been possible to duplicate concentrations in successive exposures on different trees, and from night to night. Using scales of a known age and strain, it has also been possible to duplicate very closely the mortality obtained.

DDT applied in a 5 percent emulsion of kerosene containing 3 percent of DDT, gave a residue that prevented normal development of the young California red scale insects for a period of 4 months. Dusts containing DDT were not effective against scale crawlers. Laboratory-prepared emulsifiable stocks of heavy low-grade oils at 1-1/4 percent concentration were found by the St. Lucie, Florida laboratory to be more effective in controlling the Florida red scale than the same concentrations of a light-medium low-grade oil when comparisons of living scale infestations were made one month after the treatments were applied. Two, three, and six months after applications, however, no difference could be noted in scale infestations regardless of the treatments used in these tests, and no injury to the trees was apparent. In general, the results indicated the two oils and the various amounts of emulsifying agent used in their preparation were about equal in their effect in controlling the Florida red scale. There was some indication that citrus trees stimulated by intensive cultivation were more heavily infested with the Florida red scale than those left uncultivated.

In laboratory experiments with the citrus thrips in California, anabesine and anabesine sulfate were found toxic. The latter at 1-600 was as effective as the standard tartar emetic-sugar mixture. Derris resins with sugar were promising but the action of the mixture was slow. Neither derris nor anabesine is likely to be available for the present.

Fruitflies which are potential pests in Continental United States. The Division of Fruitfly Investigations, with laboratories in Mexico City and Hawaii, has two principal functions. The first is to develop treatments of fruit which will kill any fruitflies it may carry, thus allowing tropical fruits to be imported without risk of establishing pests. The second is to study the tropical fruitflies in their native habitat, to be prepared to deal with them should they by some means become established in the Continental United States. Secondary objectives are protection of food crops in Hawaii, and cooperation with the developing Mexican agricultural economy.

During the past year, at the Mexican laboratory, studies included use of DDT against fruitflies and citrus black fly. Studies were also conducted of bait-traps, fumigation, vapor heat sterilization of fruit, relation of climatic conditions to fruitfly distribution and abundance, and of plants possibly having insecticidal principles. DDT dust in cages killed 90 percent of adults within 12 days, and fruits exposed to these flies had 75 to 100 percent lower infestation than fruits in cages without DDT. Addition of a small amount of DDT to methyl bromide applied as an aerosol increased the toxicity of the latter so that the mortality rose from 80 to 100 percent. An aerosol of DDT alone was fatal to 50 to 100 percent of fruitfly adults. The recent introduction of citrus black fly to Mexico and its establishment there is a threat to American citrus particularly of Texas and California and both treatments of fruit and field control methods are being studied.

The Mexico City laboratory through its personnel and equipment, has been able to lend much assistance to representatives of other agencies of our Government which are conducting various projects in Mexico.

In Hawaii, control of the melon fly on tomatoes was one of the subjects receiving especial attention. It was found that there was a considerable barrier, or border effect; less injury occurred in the interior of a patch than in the borders. Early in the season injury in the center was about 1/4 of that on the edge. The use of DDT on border rows, and use of a border row of squash, both showed promise.

Japanese Beetle Investigations: In 1944 the area of general distribution of the Japanese beetle was found to have increased about 3,700 square miles over the area infested in 1943. Within the generally infested area, extensions occurred on Long Island, up the Hudson and Susquehanna River valleys, and in northern Virginia and adjacent Maryland.

The milky disease of the Japanese beetle has continued to cause conspicuous reductions in infestation of the grubs wherever it has become well established in the soil. In the Mall section of Washington, for instance, where populations as high as 50 grubs per square foot of turf were recorded in 1941, and which received an intensive milky disease treatment, practically no grubs or beetles were in evidence during the spring and summer of 1944. The colonization of the organisms causing this disease is being continued as rapidly as possible.

At the request of the Office of Chief of Engineers, War Department, surveys of Japanese beetle grub infestation in maintained grass or essential turf areas were undertaken at military installations in the First, Second, and Third Service Commands during the dormant season of 1943-44. A program of milky disease treatments was started in March 1944 at installations where conditions call for treatment.

In field tests against adult Japanese beetles during the summer of 1943, 1/4 pound of DDT per 100 gallons afforded the same protection to peaches as a single application of the recommended derris-rosin residue emulsion spray, protecting both fruit and foliage for 2 weeks. A single application of a spray containing 1 pound of DDT per 100 gallons gave complete protection to the fruit and foliage throughout the entire beetle feeding season of more than 6 weeks. The spray left no visible residue on the fruit or foliage and caused no injury when used at a concentration of 1 pound in 100 gallons. Preliminary observation on more extensive experiments in 1944, on peaches, early apples, and grapes, have indicated similar trends.

DDT has also been found effective at very low concentrations against the grubs of the Japanese beetle in the soil. In a number of soil types DDT, when freshly applied at rates of 5 to 27 pounds per acre, was as effective as lead arsenate at the rate of 500 pounds per acre. Studies in the greenhouse indicated that relatively large quantities of DDT could be applied to the soil without detrimental effect on certain crops, but that others, such as beans, spinach, and tomatoes, are unfavorably affected by applications of 25 pounds or more of DDT per acre.

2. Forest Insects:

Insects attacking mature timber: Continued progress was made during the year in the application of sanitation-salvage logging to bark-beetle control, both in refinement in identification and in marking of trees susceptible to barkbeetle attack. There has been an increased interest in expanding application of this silvicultural practice to forested areas suitable to this treatment, particularly private holdings in northern California and southern Oregon. Our studies of the effect of climate and site on variation of barkbeetle abundance and consequent loss of timber were continued. This is a long-time study that will involve at least one complete cycle of western pine beetle outbreaks. In general the same low activity of this beetle reported last year was continued. However, there have been some exceptions in local attack of

trees of normally low susceptibility to barkbeetles. These attacks were made by a combination of Ips and western pine barkbeetles around logging areas. It is not believed that they will be of any very serious consequence; however, such flare-ups require careful observation and indicate that the underlying causes need further study. Possibly the breeding up of large quantities of Ips beetles in slash material precipitated these local outbreaks. The relatively low beetle population was associated with the lowest average temperature in 13 years, the greatest precipitation in 23 years, and a relatively high level of soil moisture during the growing period with diameter growth considerably above normal.

By far the most unusual and serious forest insect situation confronting us in the timberlands of the United States is the spectacular outbreak of spruce barkbeetle in the spruce stands of Colorado. Our knowledge of this outbreak is still incomplete. We know that the spruce on three of the National Forests - White River, Grand Mesa and Uncompahgre - is from 50 to 75% destroyed. Preliminary reports from a number of other forests indicate serious activities of this insect. An immediate thorough survey of all the spruce stands in Colorado is needed and every effort will be made within the funds available by shifting personnel temporarily from other work to obtain a true picture of the situation. The Forest Service has made every effort to increase timber sales in these heavily infested areas as a means of controlling the outbreak and utilizing infested timber before it has deteriorated. Biological studies are needed to determine the life history of this insect to aid in making salvage operations effective from the control standpoint. Entomologists have had no experience with this Engelmann spruce beetle. The last outbreak occurred about 70 years ago. Reports of 50 years ago based on evidence of stumps and snags indicate that most of the Colorado spruce forests were devastated in this outbreak.

Insects attacking plantations and immature timber: Considerable progress was made during the past year in cooperative studies in the application of insecticides from airplanes for the control of forest defoliators. This experimental work was aimed at improving equipment suitable for the application of the new insecticide, DDT, and at developing satisfactory formulae for the application of this material. Striking results were obtained in several small-scale applications on from five to twenty-five acre plots against such insects as the gypsy moth, the Leconte sawfly in pine, and cankerworms in oak. Incidentally these applications had marked effect on all insect life in these areas such as mosquitoes, black flies and beneficial insects as well. It is planned to expand this work the coming season in cooperation with engineers of the Department so as to anticipate the possibility of widespread application immediately after the war when planes and pilots will be available. Preliminary cooperative studies on the toxicity of DDT with the Bureau of Animal Industry indicated that this material is far safer than insecticides previously used such as lead and calcium arsenate.

A detailed study of the Saratoga spittle bug showed that it is definitely associated with the burn blight condition that is causing so much damage to young stands of jack pine in the Lake States. Further studies are being made in cooperation with the State of Wisconsin and the Division of Forest Pathology, Bureau of Plant Industry, Soils and Agricultural Engineering to determine if there is an insect-disease relationship involved in this condition. A survey of the pine stands of the State of Wisconsin is being undertaken to determine the extent of the present losses.

Insects attacking forest products: Continued assistance was given to the military agencies by providing technical advice in the prevention and control of insect damage to wood products and particularly in materials to be used in ships and at marine bases. Additional tests were made with various chemicals that are readily obtainable during the present emergency for use in controlling powder-post beetles in lumber. It was found that kerosene is effective when used as a dip or brush treatment for infested material of small dimensions. Technical advice was given to lumber companies as to the amount of borer damage present in Douglas fir timber remaining on various parts of the large area that was burned over in 1933 in Tillamook County, Oregon. This timber had deteriorated to the point where it was considered practically worthless two or three years ago but in view of the wartime demand for lumber, salvage operations have been resumed on a very large scale. Previous studies of insect conditions in the burned area made it possible to advise the companies as to which trees could be salvaged.

The control of borers which attack valuable logs, particularly logs which are stranded in the woods or at the mill site because of shut-down, has been a longstanding problem difficult of practical solution. The past summer's experiments with DDT sprays indicate that this material may give effective protection.

A series of tests were established in the spring of 1943 in the Canal Zone to determine the relative resistance of a number of Central American woods to attack by termites and the practicability of using soil poisons or the sapstream method of treating tropical species of trees. This work is of importance to the greatly expanded construction program in tropical areas. The test material was examined in the spring of 1944 and the results appear to be very good. A cooperative project in testing the resistance of chemically treated military fabrics to deterioration by termites and fungi was completed. A total of 51 chemical treatments were under test and several chemicals or mixtures were found to be effective against termites. Numerous requests were received from the War Department for help in applying termite control measures during the past year. Very destructive termite infestations were found at several Army posts where proper precautions were not observed at the time of constructing the buildings. Bureau representatives attended several training schools held by the Repairs and Utilities Branch of the Corps of Engineers and gave lectures on the control of termites.

Surveys to locate and determine the status of insect pests of the forest and the giving of advice to land managing agencies on planning and conducting necessary control work: The annual barkbeetle detection surveys which are conducted in cooperation with the Forest Service, National Park Service, Office of Indian Affairs, and private timberland owners were carried on again during the summer and fall of 1944. These surveys serve as a basis for recommendations for insect control work. They revealed lower losses than have been observed in the past 25 years everywhere except in Colorado where the spruce barkbeetle outbreak threatens destruction of a greater part of the merchantable spruce in that State, and in the vicinity of Birney, California, where serious local losses occurred. The losses in other regions were entirely offset by growth. The surveys on the Federally-owned and adjacent private lands covered about 1,800,000 acres of private land and 5,300,000 acres of Federal land. This is less than 25% of the area that normally should be covered to effectively analyze the insect situation and give advice to the land-managing agencies as to where control measures are needed. Twenty detailed reports were submitted to various agencies on outbreaks of the western barkbeetles. The Colorado spruce situation is a good example of the ability of insect populations to build up to tremendous proportions because of lack of sufficient detection surveys.

3. Truck crop and garden insects: The control of insects that destroy vegetables or transmit plant diseases has assumed an increasingly important role as an essential part of the task of producing food for the war effort. In addition to increased commercial plantings of such crops as beans, peas, potatoes, and tomatoes, the expansion of the Victory garden program has created a further demand for information on vegetable insect control. Since only limited supplies are available of some of the insecticides, such as pyrethrum and rotenone, used commonly for the control of insects attacking vegetables, it has become necessary to exert an emphatic effort to husband such supplies as were available and to develop substitute materials or other control methods. A special effort has been made to disseminate information regarding the control of insects affecting important vegetable food crops and tobacco through the timely publication of bulletins and mimeographed material as well as through the channels of the radio and the press and by personal contacts of the workers.

Truck crop insects:

Cabbage caterpillars. The investigations on the protection of cabbage in the South from losses caused by cabbage caterpillars have stressed the development or discovery of materials which might be used as substitutes for rotenone and pyrethrum. Recent investigations have shown that the insecticide DDT was more effective against all species of cabbage caterpillars than any material yet tested against these pests. It was also shown that an insecticide prepared from the plant Derris malaccensis containing little rotenone was as effective against the imported cabbageworm and only slightly inferior against the cabbage looper than the regularly recommended dust mixture containing 0.5 percent of rotenone. Various nicotine combinations as well as white oils incorporated in pyrethrum were ineffective. Dust

mixtures containing 50 percent of sodium fluosilicate gave excellent control of all species of caterpillars present on cabbage and caused little or no plant injury.

Sweetpotato weevil. Excellent progress was made on the development of tools and instruments for cleaning the fields of vegetation after harvest which serve as the winter food supply for the weevils. It was also shown that winter plowing was effective in the destruction of the food material of the weevil. The insecticide experiments to ascertain the effectiveness of regular field treatments of the crop with insecticides, such as cryolite and calcium arsenate, showed that these two materials reduced resident weevil populations but that the cost of application in relation to yield was too high to be practical.

Pea weevil. A total of 88 insecticides and combinations of insecticides were tested during the year without finding a material which gave reductions in pea weevil population equivalent to those resulting from applications of dust mixtures containing rotenone. Some possibilities were demonstrated of the usefulness of cryolite, sodium fluosilicate, and Derris malaccensis for pea weevil control.

Pea aphid: Studies on pea aphid control demonstrated that within the range of rotenone dust mixtures containing from 0.25 and 1.5 percent of rotenone the quantity of actual rotenone applied per acre rather than the strength of the mixture governed the percentage of control of the insect. The new insecticide DDT showed considerable promise in the laboratory as a remedy for the pea aphid.

Tomato fruitworm. In experiments to ascertain the most efficient combination of insecticides used for fruitworm control the indications were that dust mixtures containing 70 percent of cryolite were superior to mixtures containing from 35 to 50 percent of cryolite when applied at the same poundage of cryolite per acre. In Utah the time factor in the application of the insecticide was shown to be important since a single application of a cryolite dust mixture gave as good control of the fruitworm as three applications applied at 2- and 3-week intervals. In Ohio it was found that for the control of the fruitworm undiluted calcium arsenate was superior to a cryolite dust mixture containing 70 percent of cryolite regardless of whether the plants were or were not wet with dew. It was indicated also that basic copper arsenate was superior to calcium arsenate and that a dust mixture containing 3 percent of DDT was superior to undiluted calcium arsenate.

Substitutes for rotenone, pyrethrum, etc. A total of several hundred different insecticides or combinations thereof were tested during the year. Further progress was made in determining the efficiency of dinitro compounds as substitutes for pyrethrum in the control of the potato leafhopper on beans and potatoes. A good start was made in ascertaining the utility of the new insecticide DDT as a possible substitute for existing insecticides against a variety of pests attacking vegetables, as well as in ascertaining the tolerance of various vegetable plants to this insecticide. Good progress was made in pioneer work in applying insecticides in the form of aerosols for the control of the pea aphid, potato aphid, onion thrips, and Mexican bean beetle.

Bean insects. It was demonstrated that in the case of the corn earworm a dust mixture containing 70 percent of sodium fluoaluminate was more effective than combinations containing 40% cryolite and 10% phenothiazine or basic copper arsenate (50%), and 50% lime. Also, that cryolite with talc as a diluent appeared to be more effective than the same material with pyrophyllite as a diluent; and that the dust mixtures containing 70 percent of sodium fluoaluminate gave fair protection against the Mexican bean beetle but was not as effective as the dust mixture containing rotenone.

Wireworms. In the course of investigations for wireworm control in the Pacific Northwest, an analysis of results obtained during the past five seasons showed that the two more common species of wireworms present in that area differed markedly in their reactions to soil conditions and cropping practices, thus pointing the way for improvements in selection of crops and rotation of crops for the avoidance of severe wireworm injury. In control experiments with insecticides it was found that crude naphthalene ground to a condition where it passed through a 16-mesh screen gave as high as 80 percent actual kill of wireworms infesting the soil when incorporated deeply in the soil. Exploratory tests with the new chemical dichloropropylene-dichloropropane gave very promising results against wireworms in California. The new insecticide DDT showed considerable promise in laboratory tests. This material has not yet been tested in the field.

Potato insects. Investigations on the potato psyllid in Nebraska and adjacent States have resulted in obtaining additional information on weather factors which affect the development of psyllid populations as well as the distribution and status of wild host plants of this pest. In cooperation with interested agencies in the High Plains States a survey has been instituted which has for its objective the determination of the source which produces large numbers of potato psyllids that migrate to the potato-growing areas. In investigations on potato flea beetles in the State of Washington definite progress has been made in ascertaining the proper utilization of cryolite and calcium arsenate for the control of these pests. Studies on the biology of the flea beetles have yielded information which is invaluable in the timing of the insecticide applications. Further investigations demonstrated that some of the commonly grown varieties of potatoes in Maine were more susceptible to aphid infestation than other varieties, thus giving a possible chance to exert some degree of aphid and leafroll control through selection of potato varieties.

Beet leafhopper. Field experiments in Idaho for the chemical control of the beet leafhopper on sugar beets with dry lime-sulfur and micronized wettable sulfur in combination with pyrethrum showed decreases in adult beet leafhopper populations that averaged approximately 93 percent. In the work on the protection of tomatoes from beet leafhopper feeding, it was found that cheesecloth covers placed over tomato plants to protect them from leafhoppers must be removed before the temperatures reach a maximum of 90 degrees in order to avoid adverse effects on yield. It was found also that the cheesecloth covers

are not a justifiable added expense in years of mild beet leafhopper infestations. Multiple-hill planting in Utah of tomatoes again showed a beneficial effect as one method of compensating for beet leafhopper and curly top injury.

Sugar beet seed insects and cabbage seedpod weevil. In a continuation of insecticide tests for the control of plant bugs on sugar beets grown for seed in Arizona, New Mexico, Oregon, and Utah, it was shown that pyrethrum dust mixtures and dusting sulfurs were more effective than any other materials tested and that there was no significant difference in performance shown between various types of sulfurs. The addition of arsenicals to the sulfur did not give appreciable benefit in the control of plant bugs. In laboratory tests certain of the dinitro compounds were effective against Lygus plant bugs and the Say stinkbug, but these compounds exhibited a tendency to injure sugar beet seed plants. The new insecticide DDT gave spectacular results in the control of both Lygus plant bugs and Say stinkbug. This material is now being tested under large-scale field conditions.

Tobacco insects: In the dark fire-cured tobacco growing area of Tennessee, large-scale field tests indicated that the tobacco hornworm populations could be reduced by approximately 50 percent in any given square mile area by the use of moth traps and feeders. A further refinement on the use of gasoline for the checking of green June beetle damage to tobacco plant beds was a very definite contribution to this phase of the problem.

Investigations in the flue-cured tobacco area of North Carolina and South Carolina demonstrated that combination spray for blue mold and flea beetle control in plant beds consisting of ferriate and calcium arsenate, was compatible and that cryolite was as effective as a rotenone dust mixture in protecting tobacco plant beds from flea beetle damage. Tobacco plants dusted in the plant bed with a paris green-lead arsenate combination, cryolite, or basic copper arsenate, remained free from serious flea beetle infestation for about two weeks when transplanted in the field. Applications of these materials in the plant bed were as effective as treatments made after the plants were set in the field. Field tests indicated that basic copper arsenate had considerable promise as a dual insecticide for the control of hornworms and flea beetles.

In the investigations directed against insects affecting stored tobacco, outstanding progress was made on tests of pyrethrum-oil sprays under commercial conditions for the control of the tobacco moth in open warehouses. Extensive laboratory tests in an attempt to discover or develop a substitute for pyrethrum to be used in combatting stored tobacco pests disclosed that only the new chemical DDT was worthy of further study.

4. Cereal and forage insects:

Hessian fly. Infestations at 1944 harvest time were light to moderate in the West and East Central States while those in the Atlantic States were generally light. The studies to determine the best dates

for sowing winter wheat to avoid fly infestation have been terminated except for the publication of results. A circular summarizing these results for Oklahoma and Arkansas, based on 20 years' records, was published in November 1943, another paper based on 12 years' records in Nebraska was published as a Nebraska Station bulletin in March 1944, and two papers covering the long-term safe sowing date studies in Kansas and Missouri have been prepared for publication.

The main Hessian Fly investigation now in progress is the development of resistant varieties of wheat in cooperation with Federal and State wheat breeders. Due to its character this is necessarily a long-term activity. The resistant variety Poso 42, released, with favorable results, to farmers in 1942, has been favorably received by growers in the vicinity of Chico, California and grown there in considerable acreage.

Big Club 43, a variety of wheat being increased for release to California wheat growers, showed high resistance to the fly in the two localities where sown this year. High resistance to Hessian fly as well as to mosaic, bunt, loose smut, leaf rust, and stem rust is being combined with good quality and yield in cooperative work at the Kansas, Indiana and Beltsville, Maryland stations. In Kansas thirteen very promising advanced lines were included in eight adaptability nurseries and in Indiana one of the fly-resistant hybrids outranked the standard varieties Fairfield and Trumbull in yield tests. At Beltsville, 16 out of 201 varieties and hybrids tested in the greenhouse showed high resistance to the fly.

Chinch bug: This insect was of minor importance in 1943 except in Illinois where damage to corn was estimated at somewhat over \$1,000,000. In 1944 severe infestations have again occurred in Illinois, Indiana, Missouri, and North Carolina. In observations at Manhattan, Kansas, 20 wheats and nine barleys out of about 200 spring varieties were little injured by the chinch bug as compared with severe stunting of the other varieties. Due to wartime shortage of coal tar creosote, tests of possible substitutes for use in barriers were continued, among which DDT and "hydroformer bottoms," a by-product of oil refining, showed promise.

Corn earworm: The utilization of earworm resistant lines in the breeding program in cooperation with the Bureau of Plant Industry, Soils and Agricultural Engineering continues to offer the most promise as a means of reducing damage to corn by this important pest. Tests conducted in Illinois indicated two types of resistance in corn to the earworm, reduction of injury to infested ears and inability of the larvae to become established. Eleven families and three individual lines of corn were rated highly resistant. Among hundreds of lines examined in Mississippi test plots several showed low infestation by earworm and rice weevil. Length and tightness of husk apparently were not the only factors responsible.

Preliminary tests of mineral oil emulsions with and without pyrethrins, atomized on the ear silks, showed ^{some} possibility of effective control of earworm in sweet corn at a reduction in cost that might make their application to canning corn practicable. Favorable results were also obtained with an infusion of a bacterial disease of the earworm sprayed on the silks or injected into them. This method of control may have possibilities if a practical method of culturing the bacterium in quantity can be devised.

Insects attacking forage crops:

The pea aphid. Grazing of alfalfa in the Antelope Valley of California until March 1, 1944 prevented the development of severe early spring pea aphid infestations except in some fields that were reinfested by migrants from ungrazed fields. In previous years trials of late winter or early spring grazing in western Nevada satisfactorily disposed of severe spring aphid infestations.

Experiments in cooperation with the California Experiment Station indicated that a variety of alfalfa having high aphid resistance and increased vigor may result from systematic crossing of two aphid-resistant families. An alfalfa variety nursery was started in the Antelope Valley in cooperation with the California Experiment Station for the selection and study of lines resistant to pea aphid, nematode and wilt. Several alfalfa plants showing marked resistance were selected from many thousands of seedlings tested at Manhattan, Kansas and made available to the plant breeder for use in developing aphid-resistant strains of agronomic worth.

Lygus spp. and related sucking bugs. These bugs seriously damage alfalfa grown for hay as well as that grown for seed. Control measures are being investigated but still need to be perfected. In case studies of mixed species attacking alfalfa in Arizona, non-infested plants grew 1/6 taller and considerably heavier than infested plants.

Peanut insects. Additional evidence was obtained on the value of dusting peanuts with sulphur to control leafhoppers and on the best time and number of applications. Tartar emetic spray and DDT dust and spray have shown promise in preliminary tests for the control of the thrips causing peanut "pouts."

Grasshoppers. Although grasshopper abundance is generally lower than for several years, they continue to persist in damaging numbers in many localities of the West-central and Western States. Large-scale poisoning of adults on their favorite egg-laying grounds late in the season, and early-season baiting of roadsides, ditch banks and fencerows to kill the young hoppers before they spread into crops, have been tried during 1943 and 1944 as economical measures for prevention of crop damage. These measures offer considerable promise and need further trial. Observations during 1943 confirmed those of previous years that the numbers of grasshoppers and their eggs are greatly reduced in roadsides and field margins when broadleaved weeds

are replaced by solid stands of grass. Experiments are in progress to improve the poor results frequently obtained by baiting grass-hoppers in rank succulent vegetation, and further investigation of this problem is needed. Experiments with new bait ingredients, dusts and sprays including DN dust and DDT are in progress.

Mormon cricket. In field ecological studies six new centers were located in Nevada and one in Wyoming where Mormon crickets persist during period of general scarcity. The location of such areas and control of the crickets therein may result in prevention of general outbreaks at comparatively low cost. In experiments on the improvement of baits ammonium fluosilicate compared favorably with sodium fluosilicate.

White grubs. The flight of adult beetles was extremely heavy in southern Wisconsin in 1943, oak defoliation being more widespread and complete than in any year since the initiation of this study in 1935. With a reduction of funds allotted to this project and the closing of the Madison, Wisconsin station the results of the investigation in that State have been summarized in two published papers and one manuscript on the biology and control of the economically important species in Wisconsin.

Of several mixtures tested in Indiana as soil insecticides against the grubs favorable results were obtained with DD mixture and lead arsenate.

White-fringed beetle. In the Florala, Alabama area the average numbers of larvae per square yard in the four principal crops for the six-year period 1937 to 1942 were: corn alone, 49; corn intercropped, 69; and peanuts, 84, with serious damage occurring in some fields each year. Populations averaged much lower than that in the New Orleans area but considerably higher in the Gulfport, Mississippi, area. Crop damage ordinarily occurs mostly in the spring but severe fall damage to August-planted vegetable crops has been observed in at least one instance.

Studies in the utilization of cultural practices and crop rotations as control measures are showing favorable prospects and are being expanded. Experiments indicated that plowing under egg masses to a depth of three inches or more would reduce larval populations but larvae have never been found sufficiently concentrated near the surface of the soil to be effectively destroyed by tillage. Fine-rooted grasses have proved to be much poorer hosts for the larvae than fleshy-rooted plants. A large number of viable eggs was found in peanuts and peanut hay when harvested.

In laboratory and plot tests the new insecticide DDT was found highly effective as a spray or dust applied to foliage fed upon by the adults and caused no injury to 17 species of plants including the staple crops commonly grown in the infested area.

An intensive investigation of certain nematodes found to be parasitic on the white-fringed beetle has shown them to be common both inside and outside the infested areas but apparently not a dominant factor affecting its abundance. Several other parasitic or predaceous enemies of the beetle have been observed but none of them has been of material importance.

Insects affecting legume seed crops. Although *Lygus* spp. and other sucking bugs that attack the alfalfa seed crop in the Western States were much less abundant in 1943 than in the peak year 1941, they caused a loss of seed in Arizona alone estimated at over \$500,000, and heavy losses also occurred in 1944. Observations in that State indicated that suitable cultural practices provided considerable protection when applied on individual farms as well as throughout a community. Studies in Utah have shown that failure of as much as 90 percent of the blossoms to set seed often occurs. Much of this failure is apparently due to the scarcity of the wild and domestic bees necessary to effect pollination. Studies are now in progress in cooperation with the Utah Experiment Station on the utilization of bees to increase pollination.

The vetch bruchid was very abundant and destructive in 1943 in western Oregon and Washington where most of the hairy vetch seed crop is produced. This weevil was largely responsible for a scarcity of seed for cover-crop planting in the Southeastern States. In laboratory experiments to find effective insecticides for use in its control calcium arsenate, DDT, and rotenone were definitely superior to sodium fluosilicate in sweetened liquid baits. In field experiments with insecticides in the Willamette Valley DDT dust gave very promising results. Rotenone dust and a calcium arsenate sweetened bait spray were effective but less lasting. More applications of these than of DDT would apparently be necessary.

Insects attacking stored grains and cereal products. Six organic compounds showed considerable promise when tested as substitutes for the standard grain fumigants, supplies of which have been more or less limited by war conditions. Serious injury to germination of wheat from normal dosages of the ordinary grain fumigants occurred only when the moisture content of the wheat was 14 percent or more. Baking tests in cooperation with the Kansas Experiment Station indicated that loss of viability of wheat did not affect the baking quality of flour made therefrom, but that retention of fumigants in non-aerated wheat appeared to affect baking quality adversely.

In laboratory tests several materials including white lead paint, whitewash and a solution of nicotine sulfate were all highly and lastingly effective in preventing the cadelle and lesser grain borer from burrowing and persisting in the walls of small model wooden bins to infest clean grain newly stored in them. These and other materials, including DDT, are now being tested in full-size farm bins. The preliminary results with DDT have been particularly striking. Cooperating farmers are unanimous in indicating a need for an effective wall coating to prevent this type of injury.

Several organic and inorganic dusts, including DDT, Almicide and magnesium oxide, when added to wheat in extremely small percentages were found to protect it from insect attack. Some of these were ineffective, however, when the moisture content of the grain was 14 percent or more. One or more of these dusts may be found useful for preventing insect infestation of stored grain and other seeds to be used for planting, if not for food.

A number of materials tested as repellents in coatings for wrappers used in packaging cereals, including two chloroamides, DDT, zinc chloride and nicotine sulfate, afforded excellent protection against the insects attacking these products. Emery cloth both with and without a grit surface appeared to be highly resistant to penetration by these insects but glass and sand coated papers were not.

Laboratory studies on the relation of temperature and moisture content of grain to the development and control of insect infestation therein showed that bran beetles do not lay eggs at 65° F. or below and that little insect activity occurred until the grain temperature exceeded 70°. Bran and flour beetles bred in grain of almost any moisture content if plenty of grain dust and broken kernels were present, but weevils did not breed in grain with less than 9 percent moisture and very little in grain with less than 11 percent moisture.

Observations indicated that very little insect infestation occurred in stored soybeans in Illinois during the first year of storage.

European corn borer. Infestations in 1944 were the most extensive on record. From cooperative Federal-State surveys the loss of field corn was estimated at over \$28,000,000 and of sweet corn over \$5,500,000 and the area known to be infested was extended halfway across Iowa and Missouri and all the way across central Kentucky. Early sweet corn was heavily infested and most of it was completely ruined by the borer. Heavy infestations of potato vines were also reported in the Atlantic States.

Progress has been made in the discovery, segregation and intensification of resistance to the borer in field and sweet corn varieties and the commercial utilization of this resistance. Five out of about 350 inbred lines and open-pollinated varieties of sweet corn showed sufficient resistance to serve as parental breeding material but not additional resistant field corn lines were found among the approximately 900 tested. It was determined that appraisal of borer-resistance should include type and rate of plant growth, pollen accumulations that serve temporarily as food for the larvae on different parts of the plants, and comparative abundance of the sucking bug Orius insidiosus that preys on the eggs and young larvae. The development of commercially desirable borer-resistant lines of corn is necessarily a long-time study in cooperation with Federal and State corn breeders but is one of those most likely to yield an effective means of reducing the losses caused by this insect.

Airplane application of insecticides to sweet corn for control of the borer was tried for the first time in 1943 with favorable results. This

method of application is being and should be further developed. Of 213 new insecticidal compounds tested in the laboratory at least two gave results as good as or better than the standard rotenone. One of these, DDT, has already been given field trials with excellent results. There appear to be good possibilities of improving the efficiency and lowering the cost of the insecticidal method of control to the point where it will be more widely applicable, and this line of investigation is being continued.

Thirty-two parasite releases were made in ten States during 1943 involving 39,418 parasites and three species. In cooperation with several State Experiment Stations this work has been much expanded. A total of 457,000 corn borer larvae was collected in the fall of 1943 from which approximately 450,000 parasites were obtained for colonization in 1944. Parasitism determined in 1943 of borers collected from fields in the northeastern States during fall of 1942 ranged from 16 percent in some Connecticut fields to 69 percent in some New Jersey localities. Although results in the more western areas have been disappointing, adequate colonization of the various species throughout the borer-infested region is considered desirable.

Sugarcane insects:

Sugarcane borer. Surveys have shown that the sugarcane borer causes an annual loss in cane sugar production amounting to over \$6,000,000 in Louisiana alone, and reduced the 1943 yield in that State by more than 200,000,000 pounds.

In commercial-scale dusting of cane for control of first-generation borer applications of cryolite by airplane and ground equipment were about equally effective. Both gave a high degree of control which resulted in some instances to as much as 50 percent reduction in borers present at harvest time. In general, natural cryolite gave as good results as synthetic cryolite. Dilution of these materials gave poorer control than the full-strength dusts.

In the investigation of cultural measures of control the use of medium and heavily infested cane for seed resulted in estimated reductions of 2.5 and 3.3 tons, respectively, of millable cane per acre as compared with plantings of uninfested seed cane. Under conditions prevailing during the harvest season of 1942, an average of 67 percent more millable cane was left on the field to carry borers through the winter when harvested by machine than when harvested by hand. Almost twice as many borers survived the winter in uncovered as in covered cane trash.

Several thousand varieties of cane were examined for borer-resistance in 1944 and one was recommended to the Bureau of Plant Industry, Soils and Agricultural Engineering for use in breeding for borer resistance, making a total of 10 so recommended.

Other insects attacking sugarcane. The wartime desirability of emphasizing work on the control of the sugarcane borer necessitated the curtailing of investigations on other insect pests of sugarcane. Several of these, including the insect vectors of mosaic and chlorotic streak

diseases of cane need further attention. The yellow sugarcane aphid was abundant, particularly in some fields that were dusted with cryolite for borer control. An effort is being made to find an aphicide to combine with cryolite to overcome this difficulty.

The West Indian sugarcane mite was found to have survived the eradication attempted in 1941 that appeared last year to have been successful. It is now known to be present in at least two locations in the vicinity of Canal Point, Florida.

A sugarcane mealybug parasite, Pseudanphycus n. sp. was found to be abundant in Louisiana and apparently of some control value. Mealybugs survived submersion of infested seed cane for seven days in water at ordinary temperature but all succumbed to 14 days of submersion.

Sugarcane beetle infestations were somewhat heavier than in the past several years, but did not reach serious proportions.

5. Cotton insects:

Lines of research that are of immediate value in conserving materials and manpower continued to receive special emphasis. Included among these projects were presquare mopping with molasses-calcium arsenate mixture for boll weevil control and cryolite-bran bait for bollworms that required no machinery for distribution; chemical defoliation of cotton plants to aid in insect control and conserve labor in mechanical harvesting and hand picking; the value of flame cultivators for killing boll weevils; and how to obtain the maximum protection from limited quantities of insecticides. Some examples of developments and accomplishments in the various fields of investigation are discussed below:

Investigations of boll weevil control: The average reduction in yield caused by the boll weevil in 1943 was estimated by the Bureau of Agricultural Economics at 6.1%, as compared to 8% in 1942. In plots dusted with calcium arsenate for weevil control near Tallulah, Louisiana the average increase in yield was 278 pounds of seed cotton per acre, or 13.8%, as compared with the 24-year average of 309 pounds, or 22.2%. Although climatic conditions were unfavorable for boll weevil development early in the season, control was needed in many sections. The Bureau's recommendations of delaying dust applications until higher infestations than the formerly recommended 10% punctured squares developed, and the use of fewer applications of calcium arsenate, proved satisfactory when tried by growers.

In further investigations to determine how profitable increases of yields could be obtained from the use of reduced amounts of calcium arsenate for boll weevil control, tests on the high-yielding soils at Tallulah, Louisiana, confirmed previous results that better results are obtained by reducing the number of applications rather than the poundage per application.

In other tests in which six applications of mixtures of cryolite and sulfur were compared with calcium arsenate, the gains were 165 pounds of cotton per acre from 14 pounds of cryolite per acre-application;

67 pounds from 7 pounds of cryolite per acre-application; 75 pounds from 3.3 pounds of cryolite per acre-application; and 427 pounds from 8.8 pounds of calcium arsenate per acre-application. One pound of calcium arsenate produced a gain of 8 pounds of cotton while the highest increase from one pound of cryolite was 2 pounds of cotton.

Each year tests are conducted in cages and field plots in the hope of finding a material more satisfactory for boll weevil control than calcium arsenate. Sodium fluosilicate, the fluorine insecticide that has given the best weevil control in previous tests, prevented the proper development of fiber and resulted in significant reduction in yield in one variety of cotton, though not in others. Barium fluosilicate, cryolite, phenothioxin, DN mixtures, DDT, and other materials tested were all inferior to calcium arsenate for weevil control.

At the request of the National Cotton Council of America, a large series of tests was undertaken to obtain additional information on the effectiveness of the 1-1-1 molasses-calcium arsenate-water mopping mixture on entire fields, instead of the customary experimental plots. A total of 55 entire fields containing 276 acres were mopped at 6 localities in South Carolina, Georgia, Mississippi, Louisiana and Texas. Half of the area in 19 of the mopped fields at 4 localities was also dusted. Adjacent fields were selected for checks, and since the experimental error is large in comparing different fields, the results of one year's tests are not considered final. Mopping considerably reduced the weevil infestations early in the season, but the difference between the mopped and untreated fields were small by the latter part of July, indicating that the benefits of mopping were gradually lost as the season progressed and weevils became more abundant. The average yield in the 55 mopped fields was 83 pounds of seed cotton per acre more than in the untreated fields, which was not statistically significant. The fields that were mopped followed by later dusting gave an average increase of 290 pounds of seed cotton per acre over the check fields, while mopping alone gave an average increase in these 19 fields of 142 pounds per acre.

At Florence, South Carolina a series of mopping experiments conducted on one-half acre plots during the 14-year period 1928-1942 gave average gains of 39 pounds of seed cotton per acre from mopping, 286 pounds from dusting, and 331 pounds from mopping followed by dusting.

Results from chemical defoliation of cotton plants to control insects, improve the grade of lint, increase the efficiency of mechanical cotton harvesters and reduce the labor required for hand picking differed from last year. In the 1942 tests dusting with 10 to 20 pounds per acre of calcium cyanamide caused complete defoliation at Stoneville, Mississippi, but was not so effective in west Texas and Arizona. In the 1943 tests defoliation was better in Arizona and Texas than in Mississippi. These differences were found to be due to variations in moisture. The presence of considerable moisture is necessary for successful defoliation. This may be in the plants, in

the air, or from a rain following the application of cyanamide. Defoliation when the bolls were 30 to 40 days old did not reduce the yield nor strength of the lint, but further tests are needed on the optimum time for defoliation, dosages required under different conditions, and other factors. Because of the present shortage of farm labor, dusting with airplanes for defoliation is very popular with growers and is rapidly coming into commercial use.

Interest in control of the boll weevil by heat or other mechanical devices has been greatly stimulated by the war. In cooperation with the Mississippi Agricultural Experiment Station where flame cultivators were being tested for killing weeds in the cotton fields, green cotton squares containing boll weevil eggs or larvae were picked from the plants and placed on the ground beside the rows. Passage of the flame cultivator with torches producing approximately 2,200° C. heat caused practically no kill of the boll weevil stages within the squares. Tests were also started in the spring of 1944 with the pneumatic mechanical insect collectors that have appeared on the market, to determine if they would reduce the insect populations and increase the yields of cotton.

Pink bollworm investigations: Cultural and ecological studies for current use in the control program in the Lower Rio Grande Valley and Big Bend area of Texas received first consideration. Weather conditions in the Lower Valley for the past two years have been especially favorable for survival and have contributed to the buildup of the pink bollworm populations and spread to the coastal areas of Texas and southwestern Louisiana.

Hibernation experiments to secure information on the effective cultural practices for pink bollworm control showed the importance of producing the cotton crop early and plowing under the crop residue as early as possible for pink bollworm control. No pink bollworm larvae have been found to overwinter in free cocoons in the soil in this region and disposal of the crop residue is of primary importance.

In experiments with soil fumigants, DD mixture killed from 80% to 100% of the pink bollworms in buried cotton bolls with applications of 51 gallons per acre injected into the soil or applied in irrigation water. Smaller quantities were not as effective. This is the first material that has been found promising for possible use in soil fumigation in an eradication program.

The date of cotton planting experiment conducted under the large field cage at Presidio since 1939 was discontinued at the end of 1943 and a winter plowing and irrigation experiment started. This test showed that neither early planting nor late planting is sufficient to control the pink bollworm and must be supplemented by other cultural and sanitary practices.

Discontinuing irrigation early in the summer was found to be an important factor in preventing late fruiting in cotton and building up the overwintering population. In some fields the differences in populations due to time of irrigation were greater than from date of planting.

Over 225,000 specimens of four species of parasites were liberated during the season. Rearing of Microbracon kirkpatricki was discontinued, since it has been given sufficient opportunity to become established. Recoveries have been made in the fields where releases were made, but apparently this species is not adapted to the conditions, and permanent establishment is very doubtful.

Field inspections in the El Paso and Balmorhea Valleys of Texas disclosed the highest infestations ever recorded in these areas. The center of the heavy infestation seems to be moving westward to the higher and colder part of the El Paso Valley, indicating the acclimatization of the pink bollworm to colder winter conditions. The spread of the pink bollworm to three counties in the coastal area of Texas and two parishes in southwestern Louisiana is a serious menace to the entire cotton industry.

Bollworm investigations: Survival of hibernating bollworm larvae at Waco, Texas, was 28% in 1943 as compared to less than 1% in 1942. Despite a high survival and a heavy egg deposition early in the season, high temperatures and natural control greatly reduced damage in some areas.

In field tests a dry mix bait of 90% corn meal and 10% cryolite scattered over the plants by hand was used for the first time. Applications of 40 or 80 pounds of bait gave as good gains as cryolite dust, but smaller quantities were not effective. The use of bait has the advantage that no machinery is required for distribution and does not increase the aphids to the same extent as dusting.

DDT was the outstanding insecticide tested in the laboratory against the bollworm. It apparently acts as both a stomach and a contact poison and is the first material found effective against large larvae. Exposure to a dust cloud of 2% DDT-pyrophyllite and a suspension of DDT in water placed on the bollworms killed both large and small larvae in laboratory tests and indicated the possibility of its use as a contact insecticide. The most important feature of these preliminary tests is that for the first time a material has been found that will kill large worms. The damage caused by bollworms increases in proportion to their size and farmers often do not discover an infestation until the worms are too large to be killed by the arsenicals and cryolite previously used.

Plant bugs affecting irrigated cotton: Protection of the long staple American Egyptian cotton from insect damage is necessary to produce the high quality lint needed for parachutes and other military equipment. The dozen or more kinds of sucking plant bugs and stinkbugs that breed on other crops such as alfalfa, sugar beets and guar, and migrate to the cotton grown in the irrigated Valleys of the Southwest, reduce the yield by causing shedding of squares and small bolls, reduce the quality by staining and weakening the lint, and increase labor costs by causing the lint to stick in the bolls and making picking more difficult.

Tests were continued to find a substitute for the paris green used with sulfur for control because the copper it contains is a strategic war material, and a more effective control is needed, particularly for the stinkbugs. None of the several other forms of arsenicals and organic materials tested in field plots have been as satisfactory as paris green. Calcium arsenite gave good insect control, but damaged the plants so the yields were reduced.

In preliminary tests in the laboratory and cages DDT gave the highest kill of any material tested against this group of insects. In some tests 100% kill of some of the plant bugs and stinkbugs was obtained, but it was not this effective against all of the group and its value under field conditions is still to be determined.

Over 3,000,000 pounds of the sulfur-arsenical mixture developed by this Bureau's investigations were used in Arizona last year. This quantity was sufficient to dust 40,000 acres, and based on the gains of 271 pounds of seed cotton per acre obtained in the large scale airplane dusting experiment, increased the State production by over 7,000 bales by the use of this mixture.

Cotton aphid investigations: Aphid control was the most active project in the cotton insect program in 1943 and is closely associated with the boll weevil, bollworm, and plant bug projects because of the increase in aphid damage following the use of insecticides for these insects. The damage caused by aphids often more than offsets the gains from the control of light to moderate infestations of other insects and is the greatest obstacle to the increased use of arsenical insecticides. In tests in Louisiana during 1939-1943 the average gain from the use of calcium arsenate for boll weevil control was 128 pounds per acre and from the control of both weevils and aphids 393 pounds seed cotton per acre, or a gain of 265 pounds from aphid control.

The dry conditions that prevailed in Mississippi in 1943 were not conducive to heavy aphid populations but more damage was caused per aphid than in wet years.

When aphids were sufficiently abundant to provide ample food for insect predators, the number of bollworm eggs destroyed by predators was so greatly reduced that the aphids were an important factor in increasing bollworm damage.

Tests with synthetic materials that have been used for the control of other species of aphids failed to show much promise against the cotton aphid. However, there are so many new materials being developed that tests should be continued.

Additional information on methods of application showed little difference in results from the use of 1% nicotine in each application of 2% in alternate applications of calcium arsenate. Applications of nicotine by airplanes under field conditions by growers gave good aphid control when the air was calm, but was not effective when the dust tended to rise.

In tests comparing the effect of calcium arsenate with different chemical properties on the aphid buildup, a neutral calcium arsenate without a sticker, and calcium arsenate with low water soluble arsenic content caused significantly less aphids than neutral calcium arsenate with a sticker, standard calcium arsenate, or calcium arsenate with high water soluble content. Calcium arsenate also caused more aphids than barium or sodium fluosilicate.

The development of aphid resistant strains of cotton has progressed in cooperation with plant breeders to the point where hybridization of the pure line selections for aphid resistance or susceptibility will be started. Selections have shown a considerable increase in aphid tolerance but also a tendency toward reduction in yields and crossing will be undertaken to study the linkage of characters and to raise the level of production and resistance. Since the characters causing resistance have not been found, crosses for aphid susceptibility will also be made in an attempt to discover visible characters and accelerate the work. The recent production of a variety of cantaloupes resistant to cotton aphids has renewed confidence in the possibilities in this work.

Investigations of various cotton insects: Attention is given to the numerous insects not covered by other projects as opportunities are presented.

The survey of the cotton leafworm in conjunction with that made on Incipient and Emergency Outbreak funds provided the most complete record ever obtained of the spread of this insect. Local shortages of insecticides developed early in the 1943 season and this knowledge of leafworm distribution aided the manufacturers to divert shipments of the available supplies to the areas where most needed for immediate use.

Growers in Arizona were assisted in controlling the beet armyworm on several thousands of acres of cotton. This insect usually attacks only the seedling plants but this year considerable damage was caused to squares and bolls similar to that of the bollworm. The cotton leaf perforator also caused serious damage to considerable acreages.

Thrips were very destructive to small cotton on the Lower Valley of Texas, especially in fields adjacent to or interplanted with onions. In small plots DDT and Dinitro-ortho-cyclo-hexylphenol dusts gave good control of onion and tobacco thrips on cotton.

Parasites that attack armyworms belonging to the genus Laphygma were received from South America through the cooperation of the Division of Foreign Parasite Introduction and arrangements made with the Florida Experiment Station for liberation in Florida. It is likely that these parasites will also attack the bollworm, leafworm, and other pests of cotton.

Advice was furnished to State and Extension entomologists and to growers on various cotton insects and insecticidal problems.

Assistance was given to the Mexican Department of Agriculture in planning experiments and advising growers in the control of several cotton insects as a part of the general cooperative arrangement for work on the pink bollworm.

6. Bee culture:

Dissemination of information on the care and management of bees and other questions on bee culture, including general information: Through the medium of correspondence, meetings, news releases, bulletins, personal contact, an effort is made to promote the beekeeping industry so that not only may honey production be made profitable and attractive in itself but that every facility be given to promote the use of bees in the pollination of important crops. Other work includes the diagnosing of samples of bee diseases submitted from all parts of the country, arsenical determination of bees suspected of being poisoned, etc.

In excess of 10,700 inquiries have been answered. Twelve manuscripts have been submitted for publication during the year, 13 have been approved and 7 published. Over 700 references were added to the beekeeping bibliography. Laboratory examinations for bee diseases numbered 860. Two hundred and sixty-two analyses were made for arsenic.

Diseases, poisoning and other abnormal factors affecting bees: Diseases of brood and of adult bees as well as poisoning of bees cause an annual loss to beekeepers in excess of \$4,000,000. The loss of such bees means a curtailment in the production of honey and beeswax, but an even greater monetary loss results through reduced pollination of crops which are dependent on insects for pollination.

One of the diseases being given particular attention is American foulbrood, a contagious disease of bees which occurs throughout the United States. Satisfactory progress is being made through selection and breeding of developing strains resistance to this disease. An increase in resistance has been attained through the 5th and 6th generation with a leveling off in the 7th and 8th generation. This leveling off is attributed to the difficulty of obtaining pure, natural matings. During the last year, however, artificially inseminated queens, where the parentage was absolutely controlled, have given results superior to those obtained with naturally mated queens.

The effects of commercial application of insecticides on honeybees and other native pollinating insects are being studied to determine under what conditions they prove most harmful. In some areas poisoning has been so serious that beekeepers have had to move their colonies out of flight range of orchards and other crops to which insecticides have been applied. This saves the bees but usually causes the loss of the honey crop, by moving them to an inferior location, and also reduces the number of bees available for pollination. Losses to beekeepers in

Utah last year aggregated \$200,000, so serious that fruit and seed growers are now concerned about the poisoning problem. Last year in California and Arizona more than 10,000 colonies were destroyed because of poisoning. In previous years it would have been impossible to undertake any serious work on this problem without disrupting other projects of urgent importance. This spring, however, a man was detailed to work in the cotton growing areas of Arizona to obtain first-hand information.

Nosema apis, a protozoan parasite of adult bees, is widely scattered throughout the United States. Its life history has been fairly well studied but practically no information is available as to control measures. Nosema causes severe weakening of thousands of colonies and more especially when the presence of the parasite is accompanied with unfavorable wintering conditions. Queens shipped with package bees from the South and from California appear unusually susceptible and in many cases upwards of 50 percent of such queens have been lost within a few weeks after arrival at destination. The loss of queens during the critical rearing period means that the colony is essentially useless for honey production and is of lessened value in pollination. Funds and facilities are not available for other than preliminary observations on the Nosema problem.

Bee breeding: This project has to do with the fundamental knowledge of bee breeding and genetics. Essentially it has been impossible to make any but the slowest progress in developing superior strains of honeybees. One reason for this has been the impossibility of obtaining controlled matings. Within recent years, however, the technique of artificially inseminated queens has developed to the point, and by the use of multiple inseminations, of producing queens as productive as naturally mated ones. This technique gives tangible hope for the development of strains, resistance to disease, strains that are safe to handle from the standpoint of stinging, bees that will fly under adverse weather conditions where they are especially needed for pollination, etc.

During the past year under another project several lines of commercial stock were tested for productiveness. One line produced an average of 62 pounds per colony, while another line handled in the same manner, in the same locality, and with the same equipment, averaged 149 pounds. The potentialities in bee-breeding are as great as those in any other kind of livestock. Bees of a resistant strain which were mated artificially gave results far better than naturally mated queens where the parentage could not be accurately controlled.

Using black and yellow stock and artificial insemination data were obtained for accurately designating the degree of hybridization. In connection with this work comparisons were made between naturally and artificially mated queens. The use of artificial insemination will soon reach the point where it will be feasible to make available to commercial queen breeders breeding stock of certified matings.

Management of bees for the production of bee products--wax, honey, propolis, venom, package and queen bees--including studies on the behavior and physiology of bees: The objective is to develop methods for the evaluation of various lines of breeding stock with respect to honey production, pollination, wax production, and the production of package bees, and to compare lines of available commercial stock in the above respects. Improvements in methods of apiary management and devising and testing beekeeping equipment comes within the scope of this project. Much of the uncertainty in beekeeping stems from inclement weather early in the spring when bees are unable to fly regularly for pollen and nectar, which results in breaks in brood rearing which in turn prevents colonies from reaching maximum population at the beginning of the major honey flow. A method has been developed at the Madison laboratory of feeding pollen and soybean flour in such a manner as to make brood rearing practically independent of weather conditions. It has been possible to bring colonies into such early breeding as to enable the production not only of a maximum honey crop but of package bees as well. Through the use of this method it is possible for a honey producer or for a queen or package bee producer to prepare his colonies so as to meet predetermined shipping schedules and to plan for definite honey flows.

In connection with a study of honey production it was found that Nosema disease is responsible for a large loss of queens, very materially lowering the average production. Out of 167 package bee colonies established this spring, 41 percent of the queens were lost because of Nosema. The control of this disease may necessitate special colony management.

The inter-relationship between bees and flowers, including studies on nectar and pollen: During the past 25 years the population of native pollinating insects in the cultivated areas has seriously declined. This situation has been made worse, by increasing the acreages of crops that require insect pollination. It thus appears that the maintenance of a vigorous beekeeping industry is at least a partial answer to the serious decline in seed production. The work is being concentrated on the use of bees in the pollination of alfalfa in cooperation with the Bureau of Plant Industry, Soils, and Agricultural Engineering.

Honeybees, contrary to common belief, can and do effectively trip alfalfa blossoms but they do so largely when gathering pollen which is in contrast to only a small amount of tripping which occurs when honeybees gather nectar from alfalfa blossoms. Thus it becomes desirable to stimulate pollen gathering by honeybees and to devise ways of forcing a heavier concentration of bees to visit alfalfa. The control of plants competing for the visitation of bees is, for example, one possibility. Varieties of alfalfa have been found to vary widely in their attractiveness to pollinating insects, and this infers the desirability of incorporating the desirable characteristics through proper selection and breeding.

7. Insects affecting man and animals:

Mosquito investigations: Studies have continued on heat-generated aerosols for destruction of adult mosquitoes outside of buildings. In cooperation with physicists of Columbia University, some of these tests were made with insecticidal smokes produced by smoke generators. The particles of smoke that contained the insecticides killed mosquitoes comparably to those of aerosols that contained similar concentrations of insecticides in particles of the same size. There was less control of smoke, due to the effects of wind drifts, also they did not penetrate sufficiently into dense brush or wooded areas to give the desired efficiency on adult mosquitoes.

A giant aerosol dispenser was used experimentally as a means of protecting the workmen by killing the mosquitoes inside of a large industrial plant. This plant of 27 million cubic feet was located on the edge of a salt marsh, where mosquitoes caused workmen to threaten a walk-out. As a vehicle for the insecticide, DDT, methyl chloride was used at the rate of 10 parts per million of air, because such a concentration was considered safe by toxicologists. During the time the plant was in operation, aerosols were liberated from large cylinders as they passed through the plant on a trailer. A fan operated from a small gas engine forced the small particles to a height of about 60 feet, so that they settled slowly throughout the plant. They resulted in satisfactory kills of mosquitoes and flies. In further large-scale tests, the most desirable sizes of particles and the most efficient equipment for producing aerosols are being determined under practical conditions.

Repellents developed for the armed forces were also tested on mosquitoes in the Northwest, where they protected man from bites of Anopheles maculipennis and A. punctipennis for an average of 7 to 8 hours. Against seven species of Aedes mosquitoes, STMN, a mixture developed by the Bureau at Orlando, was the most efficient under field conditions. It gave protection for a little more than 6 hours.

A larvicide, phenothiazine, was made about three times as toxic to mosquito larvae by the addition of sesame oil, IN-930, or DHS activators. Laboratory and field tests also have shown that three different commercially available spreaders may be used for extending kerosene or fuel oil for the treatment of mosquito breeding places. Instead of 30 to 40 gallons of oil per acre, 6 gallons of oil may be mixed with water and one of the spreaders. This means a decrease in costs of materials, in labor needed, and in the use of transportation facilities. Fly sprays made of some synthetic chemicals proved to be acceptable as substitutes for pyrethrum, which is being used exclusively for control of disease-carrying insects by the fighting forces.

A liaison officer visited camps and posts of the Army and Navy in the continental United States, upon invitation from the commanding officers to inspect insect infestations and advise on methods of controlling mosquitoes and other insect pests. The liaison officer also gave lectures and brief instructions to groups of officers at the various service command headquarters.

Ticks affecting man and animals: Among lumbering activities, in woods and on military maneuvers, both Indalone and dimethyl phthalate were successfully used as sprays on the clothing below the knees as a means of protecting individuals from ticks and chiggers. These materials were effective for several days against immature stages of ticks as well as chiggers. Single applications also gave from 50 to 90 percent protection for a period of one day from adult lone star ticks (Amblyomma americanum). Mixtures of ground derris and sulfur, also sprays made of pyrethrum in deodorized kerosene gave fair protection from ticks, but caused irritation of the skin.

For ridding areas of ticks, a spray containing .1 and 0.05 percent DDT gave effective control of Ixodes scapularis for 45 and 21 days respectively. When this new tickicide was applied in powder form, 1 percent gave 78 percent control 45 days after treatment, and 0.1 percent DDT gave 87 percent control 22 days after treatment.

For control of the winter tick of horses, a wash consisting of DDT in soluble pine oil was tested and found to give satisfactory control and protection from reinfestation on several horses. More extensive tests are necessary before recommendations can be made.

For control of the spinose ear tick, it appears that treatments of soil beneath salt troughs and two or three treatments of the ears of cattle may prove satisfactory. Different tickicides were combined with a non-drying adhesive and were applied to the inside of the ears of cattle. The ones containing 10 percent DDT gave fairly good control of the infestations and protected a limited number of animals from reinfestations. Sprays consisting of creosote oil and similar materials applied to the soil under the salt troughs were effective in killing ticks, and it is believed that such treatments form a valuable adjunct to the treatment of ears of infested animals.

For control of the Gulf Coast tick, Amblyomma maculatum, field tests were made with seven different tickicides in combination with a non-drying adhesive. These tests were applied on different ranches on approximately 800 head of cattle. All of these treatments were far superior to those now in use by ranchmen. Additional field work is needed to determine the best ones.

Screwworms and blowflies: A number of wound protectors were tested in semi-field tests, and of these two were tested on a limited number of animals in the field. They appear to be of considerable value on fresh uninfested wounds. A combination larvicide and wound protector (Formula P-55), containing substitutes for diphenylamine and turkey red oil, gave results that were practically as good as MS-62. Further testing should be given Formula P-55.

In field and laboratory tests two wound protectors and a substitute for diphenylamine were tested. These are giving considerable promise.

It is difficult to obtain turkey red oil because of the many war needs for this oil and the raw oil from which it is prepared. A mixture consisting of a wetting agent and a coupling agent has shown promise of becoming a satisfactory substitute for turkey red oil. In some respects the mixture appears to have qualities superior to turkey red oil.

For control of fleeceworms tests were made with benzol as a larvicide, a protective chemical, a wetting agent, and a coupling agent. Fifty-seven such combinations were given preliminary laboratory tests. Twenty of the most promising ones were tested in field tests. Of the stock mixtures tested, eight were slightly superior to the others.

One of the common predisposing causes of screwworms in cattle is the horn fly. As a result of numerous bites over a small area of an animal day after day, the animal develops lesions which afford an excellent condition for screwworms. For horn fly control Thanite and DDT have given good results in both laboratory and preliminary field tests. Thanite has been found to be practically as good as pyrethrum as a toxicant for the horn fly, and DDT was indicated to be far superior to either pyrethrum or rotenone for controlling this pest. In fact, judging from results in preliminary field tests, DDT may control horn flies throughout the season with relatively few sprayings.

Ranch management practices for prevention of screwworm infestations were somewhat curtailed because of the restrictions on travel. The Texas Extension Service continued to disseminate information, and data indicate that the spring shearing recommendations varied from practically none in some sections to 100 percent in others. There was very little control of breeding of animals as a means of preventing screwworms. Surgical operations are being made according to the program by many ranchmen.

Cattle grub investigations: Two new diluents, namely, double ground cream tripoli and Friarite (a micronized volcanic ash) have given, in combination with cube powder, considerably better results than any of the dust mixtures heretofore tested. Dust mixtures containing these diluents are compact, flow easily from a dust can, and can readily go down through long and dense winter coats of hair into the skin and into the grub holes where they must go to contact and kill the grubs. They are less irritating to the respiratory system of the operator than the sulfur mixture formerly used. They are used with 1.5 percent rotenone and applied at the rate of two ounces per animal. It has been shown that 1 percent rotenone in pyrophyllite is as satisfactory as 2.5 percent rotenone in a sulfur diluent. The available rotenone was extended through the use of these diluents. Further efficiency was obtained from such mixtures by encouraging use of the materials only in the areas where rotenone would prevent the greatest losses. For the most part, rotenone mixtures were used on cattle that were intended for slaughter.

In the spray formula, it has been found that wettable sulfur is unnecessary for control of cattle grubs. In our tests a cube powder suspended in water was superior to such a suspension that contained wettable sulfur.

Lice affecting livestock: The short-nosed cattle louse is a widespread species and one which does not yield satisfactorily to any of the control methods now employed. A dip consisting of cube and sulfur with a reduced rotenone content is giving good results for the control of the motile forms of this species, but it does not destroy the eggs. Laboratory tests with DDT, for control of species of cattle lice have been encouraging.

A dip containing nicotine sulfate and Dethane 60 failed to give satisfactory results under field conditions.

Dog flies: Practical large-scale tests with sodium arsenite promised to be an effective control of dog fly breeding in beach deposits of marine grasses. A final recommendation of such a method should not, however, be given until further tests are made. Dog flies may be controlled inside barns by the use of a wall spray containing 2 percent DDT in kerosene applied at intervals of 10-12 days.

Indalone at the rate of 2 ounces per animal gave practical relief for about 3 or 4 hours, but a combination of Indalone and 10 percent Thanite in oil was equally effective on Coast Guard Patrol horses. Thanite used alone, however, caused severe burning. Undiluted Indalone proved to be the best of the repellents tested for use on man.

This project has been considerably curtailed by a reduction in funds.

Household insects:

Insects affecting foods. The low moisture content of dehydrated foods was found to be a limiting factor in the development of insect pests, thereby affording some natural protection. Protective cartons and wrappers were found to withstand shipment to the tropics and return. Organic chemicals available as substitutes for pyrethrum and rotenone were evaluated in tests on insects that affect foods. One of these, 2-4 dinitroanisole, was found effective in powder diluents at concentrations of 10 percent for control of cockroaches. Chemical substitutes were used without pyrethrum for control of cockroaches in many public institutions, hotels, restaurants, and other places where the health of the public was concerned.

Insects affecting fabrics. Hundreds of samples of treated fabrics of different ages show that protection for one year may be expected of many of the commercial mothproofing treatments. The evidence suggests that Mitin FF, DDT, and certain Eulans are much better.

Periodical inspections of supplies of wool show that tightly compressed bales afford some mechanical protection from clothes moths. The slight amount of injury on the outer edges of baled wool is sometimes less than the costs of fumigating the stored bales.

8. Insect pest survey and identification:

Insect pest survey: The Insect Pest Survey receives reports monthly from nearly 300 collaborators in addition to members of the Bureau from which short summaries on current insect conditions throughout the United States are made. These summaries are distributed to State workers for their use in planning control operations, estimating needs for control materials, and advising farmers and county agents of impending outbreaks. The reports are placed in the permanent file and with supplemental information obtained by a review of literature are used in directing quarantines and control operations in subsequent years. During the fiscal year 1944, some 3,500 reports on domestic insects and 1,500 reports on foreign insects were filed, bringing the total number of reports to over 430,000. There were 30 genera and 200 species added to the foreign file. The foreign file contains notes on 8,530 genera and 30,200 species, and the domestic file 7,900 genera and 23,000 species. The file on host plants contains records of insect attack on 1,930 genera and 5,175 species of plants.

About 125 requests for information on survey matter were filled. Four short summaries on insect conditions, and 1 summary for the year, and 7 Special Supplements, were issued.

Insect identification and classification of insects: During the fiscal year of 1944, identifications were reported for 59,956 different insect samples contained in 33,668 lots. Of these samples 28 percent represented insect interceptions in or on imported plants and plant products and 29 percent collections made in the course of special insect surveys conducted under emergency appropriations; 25 percent were from research and control activities of this Bureau and other Federal agencies; 9 percent from agricultural colleges and experiment stations of the various States and insular possessions; 5 percent from individuals, private agencies and pest control operators; and 4 percent from foreign governmental agencies and institutions, largely in the Western Hemisphere.

Direct assistance given the Army and Navy involved identification of approximately 2,000 samples of mosquitoes, mostly from the war areas, and nearly as many samples of miscellaneous insects collected on Army transport planes operating abroad. It included also personal instruction to 122 officers in the identification of mosquitoes and other insects involved in the transmission of human diseases. In addition, the Medical Intelligence Branch of the Office of the Surgeon General has been furnished, upon request, pertinent detailed information on all insects of medical importance known to occur in specified foreign areas; and an annotated bibliography of the literature dealing with the yellow fever mosquito, covering more than 1,200 published papers, has been prepared for the U. S. Public Health Service.

Research in insect classification and anatomy designed to improve the bases for exact identification in certain insect groups resulted in completion of 27 manuscripts, totaling 831 pages, for publication. Such research can be conducted only intermittently as the identification demands and other service work permit. The specific fields

covered by the research are dictated by the service requirements and the extent of the confusion existing in particular insect groups. During the fiscal year 1944 emphasis was placed on mosquitoes, mites, and other types of bloodsucking insects that affect the health of man, either directly or as vectors of human diseases. The projects represented by the manuscripts completed for publication were those involving classification of the Hemiptera, Coleoptera, Diptera, Orthoptera and neuropteroids, Thysanoptera, Hymenoptera, particularly ants, Acarina, and insect anatomy. Work on the project involving classification of foreign insect pests that might become established in the United States has had to be discontinued, since the exceptionally heavy load of urgent identification work leaves no time for this project.

9. Foreign parasites:

The search in South America for effective natural enemies of destructive agricultural pests, and the importation of these enemies into the United States has been continued during 1944. The importation from all sources during this period have been as follows:

<u>Pest Insect</u>	<u>Parasite or Predator</u>	<u>Country of Origin</u>	<u>Number</u>
Armyworms	<u>Pseudoarchytopsis incerta</u> Macq.	Uruguay	947
	<u>Ophion ancyleneura</u> Carn.	Uruguay	32
	<u>Phorocera</u> sp.	Argentina	271
	<u>Calosoma antiqua</u> Dej.	Argentina	248
Codling Moth	<u>Cryptus sexannulatus</u> Grav.	Canada	200
Comstock mealybug	<u>Allotropa utilis</u> Mues.	Canada	600
Corn earworm	<u>Actinoplaga</u> sp.	Uruguay	169
	<u>Paniscus</u> sp.	Uruguay	23
Pineapple mealybug	<u>Hambletonia pseudococcina</u> Comp.	Puerto Rico	6508
Vegetable weevil	<u>Epiplagiops littoralis</u> Blanch	Argentina and Uruguay	8083
	<u>Porizon harperi</u> Blanch	Uruguay	4370
	<u>Triaspis</u> sp.	Uruguay	195

In addition to the above shipments to the continental United States, 2195 Theresia diatraeae Brethes, a parasite of the sugarcane borer, were collected in Brazil and forwarded to the Federal Agricultural Experiment Station in Puerto Rico. The current program of the South American field station at Montevideo, Uruguay, includes large-scale collections of natural enemies of the cotton boll weevil in Peru, vegetable weevil in Argentina and Uruguay and corn earworm and armyworms in Uruguay.

In furtherance of the cooperative work with State organizations, colonies of the vegetable weevil parasites, Epiplagiops littoralis, Porizon harperi, and Triaspis sp, were sent to the California Agricultural Station, the armyworm enemies, Pseudoarchytopsis incerta, Calosoma

antiqua and Phorocera sp. to the Florida station, the squash bug parasite, Trichopoda pennipes to Washington and the woolly apple aphid parasite, Aphelinus mali, to Iowa. Additional colonies of the latter parasite were also sent to Mexico.

One of the principal current activities of the parasite receiving station at Hoboken, N. J., is the rearing of two codling moth parasites received from Europe via Canada. Methods of production have been developed and the New Jersey Experiment Station has been provided with colonies for field release.

One of the most important activities of the year was the completion of a cooperative project with the Mexican Department of Agriculture for the biological control of the citrus blackfly, a very destructive pest, on the west coast of Mexico. This work was aided by an allotment of funds from the Office of the Coordinator of Inter-American Affairs. Colonies of a very effective parasite, Eretmocerus serius, previously imported by the Bureau from Malaya, were obtained from the Canal Zone and released throughout the infested area in Mexico. It quickly became established and its effect in controlling the pest should very soon be evident. The control of the infestation by this means will greatly reduce the risk of spread of the pest to the citrus-producing area of California.

A new project for the biological control of the Klamath weed, a destructive range pest that is also poisonous to livestock, is being undertaken in cooperation with the California Agricultural Experiment Station. Three species of plant-feeding insects will be imported from Australia, reared and liberated in the infested areas of northern California and adjoining States. These insects, which feed only upon the Klamath weed, are of European origin and have shown promise of controlling the pest in Australia.

10. Control investigations:

Investigations of materials and methods of applying them for control of insects by fumigation: Continued progress has been made in the development of methyl bromide fumigation procedures for the treatment of plants and produce to free them of insects so that they may be shipped in conformity with quarantine regulations. Further research on vacuum fumigation of nursery stock for white-fringed beetle has shown that the previously required dosage can be appreciably reduced without risk, thus lessening the danger of treatment injury to certain types of plants. The new schedules, which cover the temperature range from 40° to 80°, have been approved for use. Five new schedules were developed and approved for atmospheric fumigation of nursery plants with soil balls of 5 in. or less in diameter. Extended tests of atmospheric fumigation of potatoes for elimination of the same pest have shown that there is no appreciable increase in incidence of rots following treatment at dosages sufficient to kill the larvae. Seven new schedules for fumigation of potatoes and other produce in refrigerator cars at temperatures of 56° F. and above were developed and have been approved.

Wartime conditions prevent the fumigation, before icing, of refrigerator cars containing vegetables requiring treatment for elimination of Japanese beetles. New schedules were consequently developed and have been approved which permit treatment under various conditions of pre-cooling and icing. Cyanide fumigation under canvas for elimination of *Parlatoria chinensis* on ornamentals was found to be impracticable under some conditions. This pest varies in resistance to methyl bromide during the year, being more resistant during the winter. The studies on delousing of soldiers' clothing by fumigation were completed, with methods and equipment developed that are applicable and effective under virtually all conditions, and these have been adopted by the Army and Navy.

Special attention is now being given to the study of fumigation with methyl bromide for elimination of Oriental fruit moth larvae in fresh fruit, and in fruit treated either before or after storage, in order that these fruits may be shipped without danger of disseminating the pest. This investigation is in cooperation with the California State Department of Agriculture.

Investigations of methods of applying insecticides: Preliminary studies were made upon the use of smoke aerosols against agricultural pests. The insecticide is dispersed in an oil smoke generated by heat. Several devices for application were developed and tested. Modifications of these, and of several Army smoke generators, were made to obtain a more efficient particle size, as this factor has an important bearing upon insecticidal efficiency. Preliminary field tests against the gypsy moth showed a high kill several hundred feet from the generator. This method of insecticide application may prove to be practicable against some types of agricultural pests.

Tests to determine the effect of insecticidal materials: In the testing of insecticides, major attention has been given to the testing of insecticidal aerosols and devices for their application in order to obtain maximum effectiveness against mosquitoes and other insects that affect the health of the armed forces and to determine their effectiveness against agricultural pests. A total of 1,141 tests with 137 samples were made on houseflies and 455 tests with 74 samples on mosquitoes, 69 samples containing substitutes for pyrethrum were tested. Several demonstrations were conducted at Philadelphia, in which a 70 million cubic foot industrial war plant was freed of mosquitoes by means of aerosol applications. Beginning with the fiscal year 1945, the investigations relating to control of mosquitoes and other pests affecting the health of the armed forces is being financed by a transfer of funds from the Office of Scientific Research and Development. As a result, it will be possible to give greater attention to problems relating to agricultural insecticides.

A total of 508 samples of synthetic compounds and plant materials were tested as sprays against houseflies. Of these, eight synthetic materials and two of plant origin showed considerable effectiveness. Ten new compounds showed promise as synergists for pyrethrum. More than 1,300

tests were made on leaf-feeding insects, using 205 new synthetic compounds and plant materials. Of these, 37 synthetics and two plant materials were found to be sufficiently toxic to insects to warrant further study. In cooperation with the Eastern Regional Research Laboratory, more than 2,200 tests were made on 237 samples of nicotine compounds against all species of insects, of which nine compounds showed a higher toxicity to the insects than nicotine alone when applied as a spray.

Insect toxicology and physiology: In the studies on insect toxicology and physiology, data were obtained relating dosage to survival time. In one dosage region, however, it was found that a low applied dosage consistently has an equal or greater toxic effect than a slightly higher dosage. This is explained on the basis of the rate of ionization of the injected poison. Investigations are being continued on the coating of certain insecticides with materials that are digestible by insects with the object of reducing the injury to plants when they are applied. Preliminary results show considerable promise.

Work has been initiated to determine how DDT kills insects. Such information would aid in determining the best ways of compounding and applying this insecticide for the control of various plant and animal pests. The material acts as both a stomach and contact poison and its effects are more or less independent of the central nervous system.

11. Insecticide and fungicide investigations:

Results of much of the work of the past year and some of the preceding year have been reported in 88 scientific articles published by the Department or in outside journals. Thirty U. S. patents have been granted members of the Bureau covering new insecticides, methods of application, etc.

Chemical investigations relating to insecticides during the past year have naturally again been concerned to a great extent with the development and improvement of insecticides for the armed forces and with means of replacing or extending the supplies of scarce materials for agricultural uses.

Chemical investigations on insecticidal plants (Derris, Pyrethrum, etc.) and their constituents: Supplies of pyrethrins continue to be critically scarce. A number of synthetic compounds have proved to have a synergistic action with pyrethrins. A method of determining the content of sesamin (the active synergistic substance) in sesame oil has been devised. A process was worked out for the preparation of practically pure pyrethrins from commercial pyrethrum extracts. This pure material is completely soluble in Freon-12, and suitable for use in aerosols. The pure pyrethrins are also of use as analytical standards for pyrethrum.

Efforts continued to find sources of rotenone to replace that formerly imported from the East Indies. Many samples of barbasco from Central and South America were analyzed for the Foreign Economic Administration. Numerous other plants were prepared for insecticide tests and one, Erigeron affinis, proved sufficiently toxic to houseflies and other insects to merit further investigation.

Chemical investigations to develop synthetic organic insecticides:

A great deal of publicity has been given to DDT recently as an unusually effective insecticide. This material, which is the technical grade of 2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane, has proved its value for the control of body lice, malaria mosquitoes, and flies, which are of immense annoyance and potential danger to the armed forces. The Bureau has been intimately associated with the development of DDT for control of these insects and has taken an active part in establishing and furthering the manufacture of DDT in the United States. Specifications have been developed for technical grade DDT and for DDT for use as a mosquito larvicide. Assistance has been given to the Army and Navy in developing formulas for DDT louse powder now in use. Means of emulsifying DDT and of preparing it in other suitable forms are being developed. An intensive program of research on DDT has recently been inaugurated for the Office of Scientific Research and Development. Work also is in progress on the applications of DDT as an agricultural insecticide for postwar use.

Numberous other synthetic organic compounds were prepared for testing as lousicides, mosquito and louse repellents, and mosquito larvicides. An additional compound has been approved by the Committee for Medical Research as a mosquito repellent for use by the Army.

Chemical investigations to develop inorganic insecticides: A cooperative study is in progress on the use of sodium fluosilicate in place of the scarcer fluoride now used in roach powders. Specifications are being worked out for a satisfactory grade of material. A 70 percent natural cryolite was found to give control of the codling moth comparing favorably with that obtained with the usual 90 percent grade.

Chemical investigations on fumigants for control of insect pests:

The demand of the armed forces for aerosol dispensors for combatting malaria and other mosquito-borne diseases has continued to increase. Because of limited supplies of pyrethrum and Freon-12, it was necessary to develop substitutes. An aerosol formula in which DDT is used with a much decreased amount of pyrethrins was worked out for the Army. Work on aerosols is being carried on for the Office of Scientific Research and Development. A study is under way of the

effect of various solvents, grades of DDT, etc., on the corrosion of aerosol containers. Much work has been done on containers, valves and nozzles for the dispensers. In addition to military uses, the application of the aerosol method of agricultural insecticides for use in greenhouse and field has been found promising.

The use of special gas-tight tents in fumigation of citrus trees with hydrocyanic acid to combat the California red scale was shown to make possible better control of the gas concentrations. A new dosage schedule was worked out for these tents, requiring only about one-third the amount of fumigant used with the ordinary duck tent. Preliminary observations were made on cyanide fumigation of deciduous fruit trees for control of the Hall scale.

Chemical investigations on accessory materials for use with insecticides:

Nicotine bentonite sprays, more satisfactory than those previously used with respect to visible residues left on the fruit, were developed. A mixture of soybean phosphatides and raw mineral oil proved to be a satisfactory substitute for soybean oil as a spreader and adhesive for lead arsenate and nicotine bentonite sprays.

Progress was made in chemical studies to identify the natural sex-attractant of the female gypsy moth.

It was found that anethole and pimenta leaf oil can be substituted for geraniol and eugenol, respectively, in Japanese beetle bait without adverse effect.

Chemical analysis of miscellaneous compounds tested as insecticides:

Approximately 900 samples of miscellaneous insecticides were analyzed, in addition to nearly 500 samples of nursery soil treated with lead arsenate against the Japanese beetle grub. Particle size and other physical properties of a number of insecticides were also studied. Analytical methods were developed for DDT, certain dinitro compounds, free lime in calcium arsenate, and sesamin in sesame oil.

Appropriation Act, 1945 under above title	\$ - -
Proposed transfers in 1946 estimates from:	
General administrative expenses	+ 72,550
Japanese beetle control	+ 386,500
Dutch elm disease control	+ 287,000
Sweet potato weevil control	+ 78,670
Mexican fruitfly control	+ 169,820
Gypsy and brown-tail moth control	+ 409,320
Phony peach and peach mosaic eradication	+ 99,340
Barberry eradication	+ 283,470
Pink bollworm and thurberia weevil control	+ 738,960
Transit inspection	+ 45,900
Total available, 1945	2,571,530
Budget estimate, 1946	2,225,800
Change for 1946:	
Overtime decrease	- 345,695
Other decrease	- 35
	<u>- 345,730</u>

[Note:--Amounts in parenthesis opposite numerically identified projects are totals of the alphabetically designated subprojects which immediately follow]

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
1. Japanese beetle control	(350,151)	(337,200)	(337,200)	- -
(a) Supervision of nurseries and greenhouses ..	191,751	181,300	181,300	- -
(b) Scouting adjacent to nurseries and greenhouses	26,400	26,700	26,700	- -
(c) Trapping to determine distribution	56,300	52,800	52,800	- -
(d) Soil treatment and trapping in isolated areas to aid in preventing spread	29,500	28,400	28,400	- -
(e) Farm products inspection	26,000	30,200	30,200	- -
(f) Vehicular inspection	20,200	17,800	17,800	- -
2. Sweet potato weevil control	68,193	69,900	69,900	- -
3. Mexican fruitfly control	(135,771)	(150,900)	(150,900)	- -
(a) Grove and packing house inspection and certification for Mexican fruitfly control	124,000	137,800	137,800	- -

PROJECT STATEMENT - Continued

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
(b) Spraying and control of Mexican fruitfly in Mexico	4,400	4,800	4,800	- -
(c) Vehicular inspection: for Mexican fruitfly con- trol	7,371	8,300	8,300	- -
4. Citrus canker eradica- tion	9,558	- -	- -	- -
5. Gypsy and brown-tail moth control	(350,667)	(359,835)	(359,800)	(-35)
(a) Inspection and cer- tification for gypsy and brown-tail moth control	102,200	104,700	104,700	- -
(b) Control operations for gypsy and brown-tail moths	248,467	255,135	255,100	-35-64
6. Dutch elm disease con- trol	(330,910)	(252,000)	(252,000)	- -
(a) Scouting to locate trees infected with Dutch elm disease	259,310	- -	- -	- -
(b) Identification of disease in trees suspect- ed to be infected with Dutch elm disease	25,500	20,700	20,700	- -
(c) Quarantine enforce- ment	10,300	45,900	45,900	- -
(d) Coordination of State work on Dutch elm disease	25,500	- -	- -	- -
(e) Removal of diseased, dead and dying trees ...	10,300	- -	- -	- -
(f) Surveys to determine where the Dutch elm disease occurs as a basis for quarantine enforce- ment	- -	131,700	131,700	- -
(g) Experimental control: work to determine what action may be taken by cooperating agencies to protect valuable elms in areas of general infec- tion	- -	53,700	53,700	- -
7. Phony peach and peach mosaic eradication	(87,028)	(89,400)	(89,400)	- -

PROJECT STATEMENT - Continued

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
(a) Nursery inspection and certification	23,600	24,100	24,100	- -
(b) Orchard inspection and control	63,428	65,300	65,300	- -
8. Barberry eradication ..	(224,220)	(253,900)	(253,900)	- -
(a) Eradication of the barberry in the 13 States where work was begun in 1918	189,920	194,700	194,700	- -
(b) Eradication of the barberry in other States ..	30,100	54,800	54,800	- -
(c) Inspection of nur- series which ship bar- berries interstate	4,200	4,400	4,400	- -
9. Pink bollworm and thurberia weevil control ..	(554,796)	(666,500)	(666,500)	- -
(a) Inspection to de- termine status and pos- sible presence of the pink bollworm and Thur- beria weevil within and without regulated areas ..	90,800	112,100	112,100	- -
(b) Regulatory opera- tions to suppress and prevent spread of the pink bollworm and Thur- beria weevil as required by Federal Quarantines on these insects	128,796	154,100	154,100	- -
(c) Control operations for suppression or erad- ication of infestations of the pink bollworm ...	166,000	197,800	197,800	- -
(d) Eradication of wild cotton in Florida for protection of cultivated cotton from pink bollworm:	94,500	115,000	115,000	- -
(e) Cooperation with the Mexican Government to control pink bollworm in- festations to prevent spread into the United States	74,700	87,500	87,500	- -

PROJECT STATEMENT - Continued

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
10. Transit inspection...	46,416	46,200	46,200	- -
11. Overtime costs	347,526	345,695	- -	-345,695
Unobligated balance	50,417	- -	- -	- -
Total available	2,555,683	2,571,530	2,225,800	-345,730
Transferred to "Salaries and expenses; Office of Information, Department of Agriculture"	+1,700	- -	- -	- -
Total estimate or ap- propriation (1944 and 1945 adjusted for comparability).	2,557,383	2,571,530	2,225,800	

INCREASES OR DECREASES

The decrease of \$345,730 in this item for 1946 consists of the \$345,695 decrease for overtime, and \$35 in the project "Control operations for gypsy and brown-tail moths" to round off the appropriation total.

CHANGES IN LANGUAGES

The estimates propose the following language for this item (new language underscored, deleted matter enclosed with brackets):

Insect and plant disease control: For carrying out operations or measures to eradicate, suppress, control or to prevent or retard the spread of Japanese beetle, sweet potato weevil, Mexican fruit-flies, gypsy and brown-tail moths, Dutch elm disease, phony peach and peach mosaic, cereal rusts, and pink bollworm and Thurberia weevil, including the enforcement of quarantine regulations and cooperation with States to enforce plant quarantines as authorized by the Plant Quarantine Act of August 20, 1912, as amended (7 U.S.C. 151-167) and including the establishment of such cotton-free areas as may be necessary to stamp out any infestation of the pink bollworm as authorized by the Act of February 8, 1930 (46 Stat. 67); and for the enforcement of domestic plant quarantines through inspection in transit, including the interception and disposition of materials found to have been transported interstate in violation of Federal plant quarantine laws or regulations, and operations under the Terminal Inspection Act (7 U.S.C. 166), \$2,225,800: Provided, That no part of this appropriation shall be used to pay the cost or value of trees, farm animals, farm crops, or other property injured or destroyed: Provided, further, That, in the discretion of the Secretary, no part of this appropriation shall be expended

for the control of sweet potato weevil in any State until such State has provided cooperation necessary to accomplish this purpose, or for barberry eradication until a sum or sums at least equal to such expenditures shall have been appropriated, subscribed, or contributed by States, counties, or local authorities, or by individuals or organizations for the accomplishment of this purpose: Provided further, [Dutch elm disease control: For determining and applying methods of control and prevention of spread of the disease of elm trees known as "Dutch elm disease" and of a virus disease of elm trees prevalent in the Ohio Valley, \$300,000, to be immediately available: Provided,] That, in the discretion of the Secretary, no expenditures from this appropriation shall be made for applying methods of control of the Dutch elm disease in any State where measures for the removal and destruction of trees on non-Federal lands suffering from the Dutch elm disease are not in force, provided such removal and destruction are deemed essential or appropriate for the carrying on of the control program, nor until a sum or sums at least equal to such expenditures shall have been appropriated, subscribed, or contributed by State, county, or local authorities, or by individuals, or organizations concerned: Provided [further] however, That expenditures incurred for removal of trees infected with Dutch elm disease from non-Federal lands shall not be considered a part of such appropriations, subscriptions, or contributions: Provided further, That no part of this appropriation shall be expended for the removal and destruction of trees infected with the Dutch elm disease except where such trees are located on property owned or controlled by the Government of the United States, or on property included within local experimental control areas [: Provided further, That no part of this appropriation shall be used to pay the cost or value of trees or other property injured or destroyed].

This item represents a consolidation of the items now carried for Japanese Beetle Control, Sweet Potato Weevil Control, Mexican Fruitfly Control, Gypsy and Brown-tail Moth Control, Dutch Elm Disease Control, Phony Peach and Peach Mosaic Eradication, Barberry Eradication, Pink Bollworm and Thurberia Weevil Control and Transit Inspection, except for funds under Japanese Beetle Control and Dutch Elm Disease Control applicable to Insect Investigations which have been transferred to and consolidated with that subappropriation, and a pro rata part of the item for General Administrative Expenses.

The appropriation language recommended for Insect and Plant Disease Control and the language recommended for the preamble are intended to provide the same authorizations and provisions for the control work involved as were provided by the 1945 Appropriation Act.

WORK UNDER THIS APPROPRIATION

Objective: In cooperation with States, to protect American agriculture from destructive insect pests and plant diseases by the application of control measures directed at eradication, suppression or prevention of

spread, depending upon the degree of risk involved, the source and extent of the infestations, and the effectiveness of available control measures.

The Problem and its Significance: Control programs currently receiving attention include insect pests or plant diseases falling into two general categories (1) those involving the eradication, suppression or prevention of spread of introduced pests that have become established in limited areas and threaten to spread to other parts of the country and (2) those of more general distribution which can be more effectively and economically controlled by federal, state and community action than by individual farmers. The principal pests dealt with under this appropriation are the Japanese beetle, the sweet potato weevil, the Mexican fruitfly, the Gypsy and brown-tail moths, the pink bollworm and *Thurberia* weevil, all of which are serious insect pests, and the injurious plant diseases known as Dutch elm disease, phony peach, peach mosaic, and black stem rust of wheat. All of these pests, if uncontrolled, are capable of taking an exceedingly heavy toll in annual damage to agricultural products and forests and affect crops of great importance. Control of these pests not only reduces or eliminates the losses caused by them currently, but prevents future damage over much larger areas. The problem is peculiarly difficult in that while safeguards must be provided against the spread of these various pests, they must still permit, to the greatest extent possible, the movement of agricultural products which are badly needed in areas where they are not grown and on which thousands of producers depend for a livelihood.

General plan: Immediate responsibility for the Bureau's program of work under this appropriation lies with subject-matter control divisions which are strategically located so as to deal most effectively with the various pests. These divisions are Japanese Beetle Control, which conducts operations also against Dutch elm disease; Domestic Plant Quarantines, which conducts activities against sweet potato weevils, phony peach, and peach mosaic, and also the transit inspection work carried on at principal distribution centers throughout the country; Gypsy Moth Control; Mexican Fruitfly Control; Plant Disease Control, which directs barberry eradication work to prevent black stem rust of wheat; and Pink Bollworm Control. In all of these control programs substantial cooperation is supplied by states in the affected areas and also in some instances by counties, municipalities and other public agencies. The Republic of Mexico also cooperates in control efforts against the pink bollworm and the Mexican fruitfly. The actual work programs in these various fields necessarily differ quite widely. The plans are therefore described in the following separate paragraphs.

Japanese beetle control: The area regulated by the Japanese beetle quarantine includes parts of Maine, New Hampshire, Vermont, New York, Pennsylvania, Ohio, Maryland, West Virginia, and Virginia, and all of Massachusetts, Rhode Island, Connecticut, New Jersey, Delaware, and the District of Columbia. There must be supervision and inspection to insure the proper treatment and handling of the products restricted by the quarantine with a minimum of inconvenience to the public. There must also be a regular survey of premises to determine the status of infestation so that adequate measures, either piece-by-piece inspection, fumigation, or general permit certification, may be adopted in each case. In addition, points in non-regulated territory considered as likely to be infested by the insect are

surveyed through the use of traps, and isolated infestations discovered are dealt with either through quarantine or through arrangements with those interested in cooperative control. Arrangements are made for air-plane, truck, railroad and mail inspection or treatment of materials as required. Efforts also are made in cooperation with research units of the Bureau to develop new, safe, and inexpensive treatments of plants and plant products to permit them to meet the requirements of inspection and certification. Practically every state in the regulated area furnishes active cooperation.

Sweet potato weevil control: Activities are designed to accomplish eradication of the weevil in commercial producing areas and to effect its drastic suppression in noncommercial areas to prevent build-up and possible spread to other areas. The work program includes (a) inspections to locate infestations and determine their intensity and possibility of eradication; (b) operations to eradicate the pest from or to control it in infested plantings by means of the destruction of potatoes in infested seed beds and storage banks, the clean-up of fields after harvest and the eradication of wild host plants; (c) cooperation with States in the enforcement of regulatory measures. Cooperating states throughout the control area are contributing to this program during the fiscal year 1945.

Mexican fruitfly control: The general work plan is (a) by periodic grove and field inspections through examination of fruit and operation of traps, to determine the presence or absence of the Mexican fruitfly; (b) by inspection of citrus packing and processing plants to insure that fruit being packed, processed, or shipped will be moved in accordance with quarantine regulations; (c) to maintain a complete host-free period, insofar as such susceptible hosts as grapefruit, sour oranges, peaches, etc., are concerned during the period from June 15 to September 1, in order to prevent oviposition and resultant increase in the fly population through the summer months; (d) to route fruit from infested groves through sterilization rooms so that any living larvae in the fruit will be destroyed; (e) to inspect markets and groves in Mexico adjacent to the regulated area in Texas with the object of holding down infestations which could easily spread to Texas groves; (f) to control the movement of citrus fruit by motor vehicles through operation of road traffic inspection stations at strategic points. The work is organized under three projects: (a) Grove and packing house inspection and certification; (b) spraying and control in Mexico; and (c) vehicular inspection. The State of Texas is cooperating in this work.

Gypsy and brown-tail moth control: Inspection and certification service is maintained from strategic points throughout the State of Rhode Island and parts of Maine, New Hampshire, Vermont, Massachusetts, and Connecticut, which comprise the regulated area. In Pennsylvania a State quarantine similar to the Federal gypsy moth quarantine is enforced in the infested area cooperatively by the Federal and State organizations. At the western edge of the generally infested area in New York and New England, there is a relatively wide strip of country which, because of the nature and type of forest growth, climatic conditions, and natural barriers, constitutes an effective barrier to rapid development and spread of infestation. In this barrier zone and in certain areas west of it intensive scouting and control work is carried on in order to locate and suppress incipient

infestations and minimize the chance of a spread to the uninfested areas to the West, and to eradicate incipient infestations which may have become established west of such barrier area.

Dutch elm disease control: Work on the Dutch elm disease consists of (a) surveys to determine where the Dutch elm disease occurs in order to afford basis for quarantine enforcement; (b) the identification of disease organisms by laboratory culture tests; (c) endeavoring to restrict the transportation of diseased material from infected to uninfested sections of the country, and (d) experimental control work to determine what action may be taken by cooperating agencies to protect valuable elms in areas of general infection. This work is conducted in cooperation with the States involved and is supported by State funds in varying amounts in States where the disease has been found. Cooperation also is extended by county and municipal Governments and other interested parties.

Phony peach and peach mosaic eradication: In cooperation with States, the general work plan is to inspect host trees; to secure removal under State authority of those found infected; to inspect nurseries and budwood sources and their environs, and make recommendations to the States relative to certification of those nurseries found free of disease; and to assist State officials in enforcing quarantines. The program followed for the past several years is predicated on (a) protection of nurseries by rigid annual inspections to prevent local or long-distance spread of the diseases to new or cleaned-up areas through the medium of nursery stock; (b) eliminating the last traces of the diseases from counties or States in which only light infections remain; and (c) protecting, insofar as practicable, commercial areas in order to permit economic peach production, and to reduce and ultimately eradicate the disease from such areas.

Barberry eradication: Barberry eradication is carried on by the Bureau in cooperation with 18 States. Close working relations are maintained with interested federal, State and local agencies, including those engaged in breeding new and improved rust-resisting grains. Within the States the work is organized under State leaders, who plan, direct and coordinate the activities of all cooperating agencies so as to clear definite areas of barberries. Timbered areas, stream banks, fence rows, and other uncultivated lands are systematically examined for barberries and the infested areas are mapped. The bushes are eradicated by treating them with salt or other chemicals, or by grubbing. Initial eradication is carried on in unworked areas. Previously treated areas are reworked as needed at about six-year intervals until all danger of regrowth from sprouts and seeds has passed. Surveys are conducted each year to determine where and to what extent stem rust is causing damage to grain crops. The distribution and planting of susceptible barberries in cooperating States is prevented by quarantine regulations. Nurseries are encouraged to grow only immune varieties for the trade and to cooperate voluntarily in eliminating their rust-susceptible barberries. The eradication program is supplemented by educational work to inform property owners about stem rust and its control and to obtain their active cooperation in locating and destroying barberry bushes.

Pink Bollworm and thurberia weevil control: The work consists of enforcement of the federal quarantines to prevent spread by artificial means; cooperation with the States to assure compliance with required control measures within the infested areas; conducting control operations to prevent the build-up of infestation that would cause increased damage and which would thereby increase the probability of spread to noninfested areas eradication of infestation where practicable; and the inspection of the cotton to determine the status of infestation in areas that are now known to be infested, and to determine the presence or absence of the insects in localities in which they are not known to exist.

Full-time employees are located in Arizona, Florida, New Mexico, Texas, and Mexico, with field headquarters in San Antonio, Texas. District and sub-district stations are maintained within the regulated areas at places conveniently accessible to the growers and cotton processors and shippers. Project headquarters for the Mexican cooperative work is at Monterrey, Nuevo Leon, Mexico. The administration of the program is on a work project basis, each work project embracing a main objective of the program.

These activities are all conducted in cooperation with State agencies, other federal agencies, farmers, agricultural associations, and organizations representing cotton growers, processors, factors and exporters, and other local agencies. An important phase is the control work carried on cooperatively with the Agricultural Department of the Republic of Mexico, which contributes the services of some 30 employees, together with equipment and incidental expenses. This work has been greatly strengthened by assignment on invitation of the Mexican authorities of Bureau personnel long experienced in pink bollworm control to the cooperative program in an advisory capacity in the interior cotton-growing regions of Mexico. A similar type of cooperation is received from the various cotton-producing States, while processors, ginners and farmers make substantial contributions to the work by incurring the extra expense involved in treatment of products to make them safe for movement out of the quarantined area, sanitation of premises, segregation of products at ginning plants, destruction of cotton stalks, controlled planting and other practices, which would not be necessary in the normal course of their operations but which are willingly undertaken as a part of the effort directed against the pink bollworm.

Transit inspection: Inspection is conducted at transportation centers throughout the country. At principal transportation centers operations are on a year-around basis while seasonal work is conducted at certain other points where the volume of work is heavy during a particular shipping season. While most of the inspectors are on the Federal rolls, cooperating agencies in the States usually assign about 12 men to assist in this work. Substantial assistance is also given by the cooperation of several thousand mail, express, and freight employees who watch for shipments of restricted materials and hold them for examination by the inspectors.

Assignments are frequently changed, new stations opened, or old ones discontinued to meet the inspection requirements occasioned by changes in quarantines or in regulated areas.

Examples of Progress and Current Program:

1. Japanese Beetle Control:

Supervision of nurseries and greenhouses for Japanese beetle control:

During the fiscal year 1944 the area under regulation was extended slightly. Approximately 100 nursery or greenhouse properties were found to be infested sufficiently to be added to those already subject to actual inspection or fumigation requirements.

A total of 72,351,300 units of plant material were certified for shipment during the year and in addition, 2,315 tons of soil and manure were certified.

During the year the quarantine was revised, shortened and some procedures simplified. A number of modifications were made in various provisions for treating regulated products as a basis for certification. These include approval of new methods of treatment and changes to make approved treatments more practicable, efficient and safe for the use of plant shippers. The instructions for the use of and methods for testing the methyl bromide fumigation chambers were simplified. Fumigation with methyl bromide of nursery stock in refrigerator cars was authorized during this year. This treatment has saved the nurserymen considerable expense and permitted them to fill their orders with dispatch under the existing labor shortages. Ethylene dichloride treatments were authorized on a limited basis for plants in shipping containers.

The widespread distribution of the nurseries and greenhouses that must be served, the shortage of manpower and the necessity for keeping automotive travel at a minimum has required much greater travel by various types of common carriers and greater expenditures incidental to travel. This has also increased the problem of furnishing the required supervision and made it necessary that inspectors work long hours.

Scouting adjacent to nurseries and greenhouses for Japanese beetle control: During the fiscal year 1944, 861 non-infested nurseries and greenhouses concerned with the movement of plants with soil about their roots were scouted. These establishments were scattered widely throughout the area regulated under the Japanese beetle quarantine and the properties and ground adjacent to them were scouted from two to four times during the flight period of the adult Japanese beetle.

Trapping to determine distribution of Japanese beetles: During the calendar year of 1944 approximately 68,700 traps are being operated in 428 localities in 18 states as compared with 42,000 during the 1943 calendar year. During 1943 traps were placed in 161 different localities, 107 with positive results. The purpose of this trap scouting of territory outside of that known to be infested is to obtain information about the distribution and dissemination of the insect. Inexpensive metal traps containing an aromatic liquid

attractant are used for this purpose. This trapping work is designed particularly to determine new localities where the Japanese beetle may have become established. It is very important to determine if the Japanese beetle is present in a locality as soon as possible in the interests of control and retardation of further spread.

The following tabulation gives the approximate distribution (by states) of the number of traps used during the summer of 1944:

Alabama	3,000	New York	5,600
Florida	4,700	North Carolina	8,500
Georgia	2,900	Ohio	5,200
Illinois	11,400	Pennsylvania	300
Indiana	3,500	South Carolina	1,900
Louisiana	1,300	Tennessee	2,000
Michigan	6,500	Virginia	1,400
Mississippi	3,300	Vermont	500
Missouri	6,000	West Virginia	700
TOTAL 68,700			

Soil treatment and trapping in isolated areas to aid in preventing spread of Japanese beetle: During the fiscal year 1944, in cooperation with State and local agencies, lead arsenate soil treatment was applied to 890 acres in outlying infestations in 53 localities in 10 states. This acreage is less than was treated during the previous year and brings the total of such treated areas to almost 6,890 acres. In addition to the application of lead arsenate the bacteria causing the milky white disease was colonized at some of the outlying infested areas as a further aid in suppression of these infestations.

For several years state authorities have increased their interest in applying soil treatments to newly discovered infestations in an effort to hold them in check. These cooperative efforts have contributed materially to delaying the spread of the beetle by retarding the development of new centers of spread. This cooperative arrangement necessitates more extensive travel for supervisory inspectors and also greater use of spraying equipment.

Farm products inspection for Japanese beetle control: During the fiscal year 1944 approximately 2,339,196 units of restricted fruits and vegetables were certified for shipment as compared with 1,650,000 units during 1943. 5,692 refrigerator cars were treated with methyl bromide under load, and in addition 61 trucks. 250 empty refrigerator cars

were fumigated with hydrocyanic gas. The number of loaded refrigerator cars fumigated during the fiscal year 1944 was greater than that of any previous year.

As a result of experimental work completed during the fiscal year 1944, it was possible to reduce the minimum temperature at which methyl bromide could be applied to car from 70° to 40° F. This authorization permits the treatment of practically all types of loadings, both dry and iced, encountered in commercial shipping.

Vehicular inspection for Japanese beetle control: During the fiscal year 1944 eight vehicular inspection stations were in operation and a total of approximately 95,000 trucks were inspected. 700 of these were found to be transporting uncertified produce and approximately 3800 live Japanese beetles were removed from inspected trucks. In addition, a large but undetermined number of live adults were destroyed in connection with the burning of straw, refuse, etc., removed from trucks at the inspection stations.

Activities were also carried on to prevent dissemination of living adult beetles in airplanes, especially those connected with the military services. The Secretary of Navy and the Secretary of War issue orders to their personnel and periodic inspections were made to check on the work and to inform those concerned on these matters. As a part of this effort new type posters have been prepared for use by Army and Navy personnel. It has not been possible to do all that should be done in the inspection of aircraft moving from ports where beetles are abundant. There has been a tremendous increase in transportation by airplane both military and commercial traffic, and the number of airports within the zone of heavy infestation have increased.

2. Sweetpotato weevil control:

Since July 1937 when the cooperative Federal-State work to eradicate the sweetpotato weevil from commercial sweetpotato growing areas was reestablished, eradication measures have been undertaken in 46 counties in the States of Alabama, Georgia, Louisiana, Mississippi, and Texas, work in one county in Louisiana having been begun during the past year. Prior to the past year eradication had apparently been accomplished in 22 of these counties and three additional counties were added during the past year; however, recurring incipient infestations were again found in three counties which had formerly apparently been cleaned up, and therefore the number of counties in which eradication has seemingly been successful remains 22.

Since 1937, eradication measures have apparently been successful on 3,745 farms. On 1,181, or approximately 32 percent of these farms, operations were completed during the past year. This is the largest number of farms on which work was completed in any one year.

Inspections were made during the year on over 30,000 properties in 73 counties in the five States of Alabama, Georgia, Louisiana, Mississippi, and Texas. During these inspections 1,280 infestations were found, most

of which were in portions of areas in which work has been but recently undertaken. The intensive work of inspectors in obtaining cooperation of growers was successful during the winter in getting nearly all storage places cleaned by the latter part of February. Winter plowing and disking by farmers were done on most of the farms in order to expose the sweetpotato weevil host materials to the destructive factors of the winter weather.

War demands for increased production have been reflected in an expansion of the industry in northwest Florida in counties adjacent to weevil-free areas in Alabama and Georgia. It was, therefore, considered necessary during the past year to make an inspection of such counties to determine their status with regard to sweetpotato weevil infestations. Spot surveys were made in 14 counties, only one of which, Bay, was found to be infested.

Fumigation with methyl bromide of sweetpotato plants was continued in Louisiana and introduced on a community basis in the heavily infested areas of Texas to enable farmers in these areas to produce their own plants and transplant to the fields without danger of spreading the sweetpotato weevil. This procedure has considerably augmented sweetpotato production in these important commercial producing areas. Studies are being continued for the improvement of fumigation procedures and their introduction into other infested areas as the means of helping to meet increased demands for pest-free plants for this important food crop.

3. Mexican fruitfly control:

The regulations governing the movement of citrus fruit in the area regulated under quarantine on account of the Mexican fruitfly were modified to lengthen the fruit harvesting season from April 30 to June 15 for grapefruit and to permit the harvesting of oranges throughout the entire year. These changes were made with the understanding that if inspections disclosed infestations which might be a means of spreading the pest through shipment of fruit it would first be treated by a method developed through research which would kill living stages of the fruitfly. The general adoption of these new procedures have continued to give protection to uninfested areas and at the same time provided a way whereby the Texas citrus grower could harvest and ship his fruit throughout a normal fruit harvesting season without materially increasing the cost of handling and packing. The modified requirements and the general adoption of treating when required has been the most important change in the work under this project.

During the past season 62,372.3 tons of grapefruit and 26 tons of oranges were treated. Oranges are only infrequently infested in Texas so the treating requirements were enforced only in a few cases to safeguard their shipment. The treatment program has been wholeheartedly accepted by the citrus industry as a method of not only preventing the shipment of fruit infested with live fruitfly larvae, but it has also proved of value in improving the keeping and shipping quality of the fruit during the late spring months. The amount of fruit sterilized during the past season increased from 23,102 tons to 62,398.3 tons.

The total amount of citrus fruit produced in the regulated area of Texas increased from 54,364 in 1942-43 to 59,166 equivalent carlots during the 1943-44 season. The following table gives the volume of shipped and processed fruit for the immediate past season as well as for the three preceding seasons.

	Equivalent Carlots			
	1940-41	1941-42	1942-43	1943-44
Rail	10,904.2	18,566.2	27,995.0	29,387.1
Truck	12,728.2	9,694.9	5,061.0	5,472.1
Boat	65.0	0.0	0.0	0.0
Express and Passenger Cars	860.0	820.0	920.0	1,160.0
Processed	16,640.9	16,606.3	20,388.0	23,147.0
Total carlots	44,198.3	45,687.4	54,364.0	59,166.2

Approximately five times as many flies were trapped in the regulated area during the past season as were taken during 1942-43, and infested fruit was found on 576 properties. Because treatment facilities were generally available and used this season and all infested fruit could be promptly and properly handled, loss to the growers and the fruit packers was very appreciably less than average.

Inspections for infested locally-grown and shipped fruit in the Mexican towns of Matamoros, Nuevo Laredo, and Juarez were continued. At Juarez where an infestation in locally-grown peaches had been found in 1941 the continued inspection and study seems to indicate that the fruitfly infestation in that locality is a result of infested fruit being shipped from interior Mexico to the border rather than through fly migration from native wild hosts. The control of the Mexican fruitfly at Juarez is important since some carload shipments of deciduous fruits frequently move out of the El Paso, Texas, area. It is believed that the close inspection, trapping, and collection of insect damaged fruit on the Juarez city markets will provide assurance that no major infestations will develop on the Texas side of the Rio Grande in that area.

Two road stations in Texas were again operated throughout the season in cooperation with the Pink Bollworm Division of the Bureau. The location of these stations makes them excellent sites not only for inspection of fruit and cotton but for the work of the Border Patrol of the Department of Justice, and through a cooperative arrangement they were utilized by the Justice Department for that purpose.

4. Citrus canker eradication:

During the fiscal year 1944, intensive inspections were continued in areas where infections of citrus canker had existed in former years in the State of Texas, and scouting inspections were made of old Poncirus trifoliata hedges and dooryard citrus trees in the north-central and northeast parts of the State. The work was conducted on a seasonal basis from October to March, during which time competing vegetation does not interfere with the finding of P. trifoliata seedlings. More

than 751,000 trees were inspected on 3,894 properties in 35 counties of the State, and a total of 4,315 P. trifoliata seedlings were removed from 388 properties in four previously infected counties. Inspections were also made of 44 citrus growing nurseries involving 76,423 citrus trees in five Gulf Coast counties.

No infections of citrus canker were found during the fiscal year, the last previous infection having been found in January 1943. P. trifoliata seedlings are removed and destroyed in order to eliminate host plants wherein this serious disease of citrus might develop undiscovered in localized areas. It has been demonstrated that the disease can persist in an incipient state for a number of years in such trees and later break out into epidemic proportions.

It has not been possible to thoroughly inspect all possible locations wherein this disease could persist. The Act providing appropriations for the fiscal year 1945 does not provide funds for work on the eradication of citrus canker and the project was discontinued as of June 30, 1944.

5. Gypsy and brown-tail moth control:

Inspection and certification: There was a considerable increase in the quantities of pulpwood inspected and certified for movement to paper mills for conversion into war products.

Improvisations and substitutions in the lumbering industry required more than usual vigilance on the part of inspectors supervising shipments of wood products. Many items that under normal conditions are considered undersized or waste were utilized to meet the enormous demand for lumber and other wood products for war uses. In some cases lumber was inspected the same day that the trees from which it was cut were felled. Some of this unseasoned material was shipped round edge, requiring inspection of each board. Many egg clusters were discovered during inspection of this green material.

White pine of small diameters and poor quality was felled and shipped under inspection for use as blocking and crating such war materials as jeeps, coastal targets, light and heavy trucks, guns of all sizes, and tanks. Approximately 200 board feet are used as blocking in each of the hundreds of carloads of war equipment leaving the infested area.

Edgings, formerly a waste product of lumber mills, were used as crating material, thus adding another item to the inspection list. Used railroad ties by the thousands were ripped up from abandoned rail lines in infested sections and shipped to distant points. Inspection of one lot of 2,708 ties destined to non-regulated area resulted in the removal of 84 egg clusters.

New England nurseries were handicapped by the labor shortage, dry weather, and a prohibition on the use of new lumber or cartons for packaging and shipping their stock. Nevertheless inspections and

certifications indicated that they did a good volume of business during both the fall and spring shipping seasons.

There was a light general gypsy moth infestation in the regulated area in the summer of 1943. This was responsible for a reduction in the number of infestations removed from products inspected. In conjunction with the inspection of 90,056 shipments, there were removed 349 egg clusters, 230 larvae, and 18 pupae.

Inspectors were stationed on certain highways leading from the infested area just prior to the Christmas holidays and again for 10 days in June. Thirty-three truckloads of uncertified products were intercepted and the drivers obliged to comply with certification requirements before proceeding.

Foremost among the new activities undertaken was the fumigation of Christmas trees, performed in 1943 on a much larger scale than the few cars fumigated during November and December 1942. Three times as many Christmas trees were moved under certification in 1943 as compared to 1942. A total of 419,133 trees were certified. Of these, 262,818 trees were shipped in 136 box cars after fumigation with methyl bromide. To further facilitate Christmas tree fumigation, tests were made in February of methyl bromide applied at low temperatures.

Information assembled on the intensity of infestations of the gypsy moth in areas not included under quarantine indicates the need of extending the regulated area and to make other modifications in the quarantine to safeguard uninfested sections through the movement of products. A revision of the quarantine regulations is under consideration which should become effective in the near future. In the meantime administrative instructions have been issued providing for removal of the present embargo on the movement of Christmas trees from the heavily infested area and permitting movement when they have been treated under supervision.

Control operations: During the fiscal year 1944 a new type of apparatus, consisting of rotating spinner discs attached to a biplane, was designed by project employees for use in applying arsenate of lead, natural cryolite, and DDT in concentrated spray form. Observations made at the close of the year indicate that very heavy mortality to gypsy moths was caused by arsenate of lead and cryolite, and that the pest was eradicated from the twenty-five acres of woodland growth treated by airplane with DDT at the rate of five pounds per acre. Twenty acres were so treated prior to development of leaves and gypsy moth hatch. The larvae emerged from the eggs, but none developed beyond the first larval instar, a very high percentage being killed by contact with DDT crystals before leaving the egg masses. The DDT crystal deposit on bark, leaves, and debris was lethal to gypsy moth larvae for a period of approximately six weeks, and in fact, to practically all other species of insects present in the treated areas.

The distributing apparatus atomized the spray materials to the consistency of a mist which drifted through the forest canopy and was deposited evenly throughout treated areas. The use of this season of

insecticides in concentrated form, especially DDT, and their distribution by aircraft definitely justifies increased use of this very effective and economical method of pest control as soon as conditions will permit.

During July and August of the fiscal year 1944, in cooperation with affected states, a survey with traps baited with a sex attractant was made throughout approximately four million acres of woodland area. More than two and a half million acres were treated beyond the generally infested area in New York State and more than a million acres in Pennsylvania around the periphery of isolated infestations. Smaller areas were trapped in Vermont, Massachusetts, Connecticut, and New Jersey. Light and scattered infestation was found beyond Albany and Schenectady Counties in thirteen townships in Saratoga, Fulton, Montgomery, Washington, and Essex Counties in New York. Results were negative in Pennsylvania and in other portions of New York. The acreage surveyed by this relatively inexpensive and very effective method is considerably larger than that so covered in any previous year.

As the result of manual surveys by experienced inspectors, information concerning the status and intensity of infestation was obtained throughout practically the entire barrier zone and in Pennsylvania. The object of this survey was to locate areas on which there was infestation of sufficient intensity to represent an appreciable hazard of natural spread. The more hazardous areas were treated to the extent available funds would permit by application of insecticides from airplanes or ground spray machines, by creosoting egg masses, or by applying burlap bands on trees in infested areas of small size.

Progress in eradication: During the year slightly more than four hundred square miles of the isolated Pennsylvania area of infestation which totaled approximately nine hundred square miles, was released from the restriction of the State Quarantine, it having been determined by intensive surveys that previously existing infestations had been eradicated.

Marked increase in intensity of infestation: Due to climatic conditions and other factors which were very favorable to pest development, a decided increase in intensity of infestation, especially in north central Massachusetts and in the Cape Cod area occurred in 1944. At the end of June, there was twenty-five to one hundred percent defoliation by gypsy moths on approximately thirty-five thousand acres of woodland, practically all of which was located in the Cape Cod area of Massachusetts. A similar degree of defoliation occurred on more than three hundred thousand acres of valuable forest area not only on Cape Cod, but also in other portions of Massachusetts, as well as in southern New Hampshire, and Rhode Island as the season advanced.

The following table compares certain results in the work area for the fiscal years 1943 and 1944:

FISCAL YEAR	ACRES SURVEYED	ACRES TREATED		ACRES
	By Traps Baited with Sex Attractant	By Ground Sprayers	By Aircraft	DEFOLIATED (25% to 100%)
1943	2,949,000	879	2,047	44,500
1944	4,185,000	1,312	1,261	34,800

6. Dutch elm disease control:

The appropriation language for the fiscal year 1945 included provisions not contained in earlier appropriations and contemplated important modifications in the Dutch Elm Disease work program. Some of the changes instituted as a result of the new language have been operative for a short time only and it is not possible at this time to appraise the full effect the revised program will have on the control of this introduced disease. The summary which follows includes reference to work done prior to the revision of the program, discussion of the current program, and progress that has been made under the new setup.

For convenience various activity headings are inserted, but not all of them specifically apply to activities now under way. The statements under the first heading are concerned with activities which are no longer a part of the current program.

Removal of diseased trees and related work: On February 14, 1944 the removal and destruction of elm trees infected with Dutch elm disease or infested with bark beetles which may carry the disease, was discontinued except for experimental purposes. The only tree removal work now contemplated will be that associated with experimental control plots designed to test methods of local control.

During that part of the fiscal year 1944 when these activities were carried on 1,770 elm trees and parts were removed and destroyed and 198 elms were pruned. This represents about 10% of the number of trees removed or pruned during the fiscal year 1943.

Identification of fungus and trees suspected of being infected by the Dutch elm disease: During the fiscal year 1944 a total of 14,227 samples of all types were submitted from the field. The Dutch elm disease organism was identified from 1,736 of these specimens. Noteworthy progress was made in 1944 in adapting and using the wet plate culture method for growing and identifying the Dutch elm disease fungus from galleries of elm barkbeetle cut from trees, branches and elm material suspected of harboring the fungus. This wet plate culture method involves an increased amount of laboratory work as compared with that required for agar plating specimens of symptomatic twigs and branches. It permits identification, however, of the fungus from a great variety of material collected in the field at various periods

of the year, and may often yield evidence of the presence of the disease in a new area before secondary spread occurs and symptomatic diseased trees develop. It is particularly valuable for determinations of the presence of the disease during the winter when bark and wood samples must constitute the bulk of all samples taken in the field.

The method of identification by agar plating twig specimens collected from symptomatic trees will continue in use as in the past. Its use, however, will be restricted largely to the period when samples collected from trees in foliage are being examined.

Surveys to determine where Dutch elm disease occurs: During the fiscal year 1944 scouting for trees infected with the Dutch elm disease and infested by the bark beetle carriers of the disease was performed at the following locations: (1) About the Major Region and the Associated Areas of Wilkes-Barre, Pa., Susquehanna County, Pa., and Binghamton, N. Y.; (2) in and about active and apparently inactive Isolated Areas; (3) in areas where the disease has never been found, but where it may have had opportunity to become established; and (4) in observation plots within the Major Region.

During the fiscal year 1944 the Major Region and Associated Areas where the disease occurs increased approximately 2,647 square miles, whereas an increase of only 1,621 square miles was recorded in 1943. Ninety-three new townships were added to this Region in the fiscal year 1944 while only 51 were added in 1943. Extensions in the disease area occurred around the Major Region and Associated Areas as follows: From 8 to 11 miles northeast in Connecticut; 11 miles north in Massachusetts; from 4 to 16 miles northwest and northeast, respectively, in the Albany, N. Y. section; from 7 miles south to 24 miles northwest in the Binghamton area, (where the greatest extension last year was 15 miles); and 11 miles west in Pennsylvania.

At the Athens, Ohio Isolated Area new disease extensions were discovered 18 miles west and 24 miles northwest. No extensions were found in the Indianapolis, Indiana Isolated Area.

Early in the third quarter of 1944, scouting in the vicinity of Brunswick, Md., (for some years an apparently inactive old disease center), resulted in the discovery of an outbreak of the Dutch elm disease in the Tuscara River and Monocacy River Valleys, extending from a point on the Tuscara River east of Point of Rocks, north across the State to Emmitsburg, Md., and east 10 miles to Middleburg in Carroll County, Md. This outbreak constitutes a threat to elms in the National Capitol. Surveys made after the outbreak was discovered found 22 diseased elms in an area in Frederick and Carroll Counties totaling 263.4 square miles. The location of these diseased elms was reported to Maryland State authorities. They took prompt action by destroying the infected trees.

No diseased elms were found at the old disease centers of Old Lyme and Preston, Conn., Baltimore and Cumberland, Md., and Wiley-Ford, W. Va.

Extensions of the disease area found during the year added 44 townships and approximately 1,360 square miles to the Isolated Areas.

Enforcement of quarantine on Dutch elm disease: When all elm removal work was terminated in February 1944, increased emphasis was placed on quarantine enforcement and on the detection of elm movement from the area neglected on account of the Dutch elm disease. There have been reported violations of the embargo on the movement of elms or elm material with bark attached from the infected area.

Nurseries desiring to ship elms to points where the trees could be kept under observation by Dutch elm disease inspectors have had their stock inspected and certified for movement on an experimental basis. Utility companies and wood dealers have cooperated through avoiding illegal movement of elm material.

To retard and, insofar as practicable, prevent the artificial spread of the Dutch elm disease and its vectors from known areas of infection to disease-free areas, the work program for 1945 will place special emphasis on surveys to (1) determine movement of elm or elm material from regulated to non-regulated areas; (2) detect violations of the quarantine; and (3) carrying out of activities which will acquaint all shippers and users of elm of the quarantine restrictions.

It is proposed to revise the quarantine regulations to include new territory where the disease has been found. With the information now available concerning this disease it is thought that it will be possible to provide methods of inspection and certification for nursery-grown elms from noninfected establishments within the area to nonregulated territory. The proposed revision of the quarantine may, therefore, change the character from the embargo to the permissive type.

Experimental control work to determine measures that may be employed to protect valuable elms from Dutch elm disease: An important phase of the work on Dutch elm disease which was contemplated and provided for by the language included in the Act authorizing work for the fiscal year 1945 is experiments to determine what can be done by local communities to protect valuable elms in areas of general infection. Observation plots to determine the status of the disease within the Major Disease Region were commenced in New Jersey. Three plots of 75 square miles each were established. In two plots only scouting was performed while in the other scouting and sanitation work was performed within a two-mile radius from the center. Of the

1,736 diseased trees found during the fiscal year, 809 were in the above 225 square miles of territory. The activities in these plots are planned to (1) produce information on the development of the disease and barkbeetle population under uncontrolled conditions; and (2) to learn the effects of control work in local areas surrounded by territory in which the disease and insects were not controlled. The information obtained should aid in forming a basis for recommendations to State, local and private agencies, where local control of the disease was desired.

The area or plot, referred to above, where both intensive scouting and sanitation work was carried out during the calendar year 1943 was selected for the site of one experiment. All diseased and barkbeetle infested elm material within two miles of the center was thoroughly removed. In the course of this work 133 diseased elms were found and destroyed and four trees were pruned. Parts or all of 39 trees infested with barkbeetles were removed and destroyed, and six trees having such material were pruned. Preliminary scouting and removal work in this plot, to date in the calendar year 1944, indicated that a reduction in diseased and barkbeetle infested material might be expected as a result of the control work performed thus far. Only 13 diseased elms were found within two miles of the center. Eleven of these were removed and destroyed and two were pruned. Work for the year, however, is not complete and results cannot be judged on a one or two year test.

7. Phony peach and peach mosaic eradication:

During the fiscal year 1944 cooperative Federal-State inspections for the phony peach and peach mosaic diseases were made in 234 counties, in 16 southern and southwestern states, extending from South Carolina to California. Over 10 million trees were inspected and 52,526 trees were found to be infected with these diseases in 85 counties. Practically all the diseased trees found in the areas scouted were removed, except for a relatively small number in California and Colorado, which will be removed during the summer of 1944. Inspections included the environs of 196 nurseries and nursery stock dealers, growing more than 5 million young trees, and 53 budwood sources during the spring of 1944. Seventy-two nurseries and their environs contiguous to the infected areas and doing an interstate business were also inspected in Arkansas, Texas, and Utah. Only 2 dealers and 3 nurseries failed to meet the certification requirements of the standard State quarantines. The successful results of this annual inspection of nurseries and budwood sources is reflected in the fact that there has not been any known spread of these diseases through shipments of nursery stock during the past 8 years.

During the past year mosaic disease was found in 2 new counties in Oklahoma and one in New Mexico. Some increase in the incidence of mosaic diseased trees was found in Colorado over those found the previous year and slight increases were noted in California, Texas, and Utah. Fewer diseased trees were found in Oklahoma this year than last, although 33 counties were inspected as compared to 2 last year. Inasmuch as no mosaic infections were found in 4 counties in Texas and Utah for the third consecutive year, these are now considered as free from the disease.

In the phony infected southeast states substantial reductions continued in the incidence of phony infected trees in areas that have received adequate annual inspections. However, the incidence of the disease is increasing in commercial areas of central Georgia and Alabama and at certain points in Mississippi, Louisiana and Arkansas where it has not been possible to do the inspection work necessary to detect diseased trees promptly.

In the entire phony infected area 187 counties in the 10 remaining infected southeastern states were inspected and infections were found in 65, or 38 less than in the previous year. For the third consecutive year, no infections were found in 21 counties in Louisiana, Mississippi, Missouri, Tennessee, and Texas. These counties are now accepted as being free from the phony disease. In addition, no infection was found for the third consecutive year in the last remaining county in the State of Illinois. This is the 7th state to be freed from the phony disease since 1935. Inspections were made during the year of over 8½ million trees, 44,731 of which were found to be infected and of which 98% were in Alabama and Georgia. Accomplishments in the 7 less heavily infected states are permitting increased efforts in Alabama and Georgia, in which states the incidence of the disease remains high and which include important areas of extensive commercial production.

Current work programs contemplate (1) annual inspection of nurseries and their environs in states infected with these diseases and of budwood sources in the 7 southwestern mosaic infected states, (2) inspection of orchards and dooryard plantings in commercial areas of the southwestern mosaic infected states, (3) inspection of previously infected and adjacent properties in states contiguous to the heavily infected phony area in Alabama and Georgia until such properties have been found free from disease for 3 years, (4) gradually increased emphasis on inspection of orchard and dooryard plantings in commercial, heavily infected phony areas in Alabama and Georgia, (5) elimination of diseased trees in cooperation with states, counties and growers, and (6) cooperation with states in enforcement of their quarantines.

3. Barberry Eradication:

During the calendar year 1943, barberry eradication work was affected by numerous problems and difficulties arising from war conditions. Labor was obtained in compliance with War Manpower regulations from the younger and older age groups and included high school students and teachers, older men incapacitated for work in industries, discharged veterans, and farm workers who were available between the busy farm seasons. The flexibility of the work program made it possible to shift from one locality to another and increase or decrease the work load as the number of available laborers changed from time to time. Field work was confined largely to re-eradication in areas where there was immediate danger of reseeding from bushes reaching the fruiting age in initially worked areas, and where known locations of barberries near grain fields menaced growing crops.

Stem rust control measures include barberry eradication, the use of improved resistant varieties of grain, and early sowing of spring grains. Over 312,600,000 rust-spreading bushes have been removed from the grain-producing areas of 17 states. As a result the average date that rust appears in the northern United States is much later than when barberry bushes were widely distributed. Progressive farmers and others having an interest in agriculture recognize that the eradication of barberries is one of the major factors contributing to a reduction in the losses caused by stem rust which amounted to 48,000,000 bushels annually during the 14-year period 1915-1928, and 24,000,000 bushels annually during the next 14-year period. This reduction represents a saving conservatively estimated at \$20,000,000 annually, an excellent return on the money invested. In addition, stem rust control measures have resulted in larger per-acre yields of better quality grain and in a more stabilized food supply. This has been of special value to the war effort in aiding the accumulation of grain surpluses that permitted increased consumption of cereal crops for food and feed, and for production of industrial alcohol for war uses.

Accomplishments in barberry eradication in 1943 were less than those of the previous year due primarily to war conditions. Nevertheless, 1,715,933 barberry bushes were destroyed in 252 important grain-producing counties, of which 244,062 were the common barberry, and the remainder native species. This included locating and eradicating the barberries found in areas aggregating 5,456 square miles of territory and re-inspecting 11,117 previously infested properties. More than 4,000 of these

properties will require no further work. Barberries were located and destroyed on 2,132 properties, of which 1,588 were reinfested and 544 new locations. A summary of the eradication work by states is shown in Table 1.

About 67 percent of the approximately 1,032,000 square miles within the barberry eradication area of the 17 cooperating states is now practically free of rust-susceptible bushes, and has been placed on a maintenance basis. This involves nearly all of South Dakota and Wyoming, and most of the area represented by the States of Montana, Missouri, Nebraska, North Dakota, and Indiana. There are approximately 336,000 square miles, largely in states bordering or east of the Mississippi River that require barberry eradication work. In some areas where the original bushes are abundant and have existed for many years, several periodic workings will be necessary to complete the eradication, while 1 or 2 will be sufficient for those areas with a few scattered bushes. Of immediate importance are areas last worked about 6 years ago which were originally heavily infested with barberry bushes. These areas should be reworked immediately, because they have become reinfested with bushes that are now beginning to produce fruit. Regrowth in these areas comes from barberry seeds which may persist in the soil and germinate over a period of 10 or more years. Since these new bushes are able to produce seed when about 6 years old, their systematic removal must be performed at the proper time interval to preclude seed production and reinfestation of worked areas.

Since the barberry eradication program began, bushes have been found on 128,071 properties. Of these, 42,948 are within areas now on a maintenance basis. Some of the remaining 85,123 properties will require only one more inspection, but most of them are in the generally infested area where continued effort will be necessary to complete the elimination of the barberries. Table 2 indicates the present status of the barberry eradication program.

During the 1943 growing season, stem rust on wheat was very light west of the Mississippi River. There was some damage in a few localized areas, especially in parts of Missouri and Iowa. Barberry bushes rusted later than usual, and less than the normal amount of inoculum of wheat stem rust developed in northern Mexico and in Texas during the spring and early summer. Only slight damage resulted from the northward spread of the rust. Both in the South and in the western part of the Mississippi Valley there was more stem rust of oats than of wheat. In the eastern states the situation was the reverse of that in the West. There was more abundant development of stem rust of wheat, especially in Virginia, West Virginia, North Carolina, Kentucky, and southern Ohio, while stem rust of oats was light. Also, in the Virginias, heavy infection developed early on barberry bushes, and local outbreaks of the disease caused severe damage to wheat in barberry infested areas. Stem rust was severe in the Palouse area of Washington State where losses were estimated conservatively to total 150,000 or more bushels of wheat. Observations indicate the rust originated on barberry bushes within this area and that very little, if any, was from outside sources. The situation in 1943 in the Virginias and in Washington State provide additional evidence on the importance of barberry bushes in starting damaging epidemics of stem rust.

Just as there are many varieties of wheat, oats, barley, and rye, there likewise are many varieties and races of the stem rust fungus. Certain varieties of grain are highly resistant to some of these races, but very susceptible to others. New races are produced and old ones perpetuated on the leaves of barberry bushes. Thus the removal of barberries reduces the opportunity for the fungus to develop new races capable of attacking new and improved resistant varieties of grain, and in addition retards the perpetuation of prevalent races. Studies of the distribution of physiological races in 1943 indicate that stem rust in the western part of the barberry eradication area had a separate origin from the rust in the eastern States.

Race 8 of the oat stem rust was sufficiently prevalent in 1943 to cause concern regarding its future effect on the performance of Vicland, Boone, Tama and several other new improved resistant varieties of oats, most of which were derived from Victoria x Richland crosses. More than 20 percent of the total isolates of oat stem rust were of races 8 and 10, both of which attack the new varieties. Although there have been indications during the past five years that race 8 might become more abundant, the sharp increase in prevalence in 1943 was unexpected since the previous high was about 6 percent in 1940.

The identification of physiologic races of wheat stem rust from 55 viable collections obtained from barberries, grains and grasses in the Palouse area of Washington and Idaho resulted in 65 isolates comprising 14 races. These were all identified as previously described races, although some of them could have been referred to as new ones on the basis of minor but apparently consistent differences. These differences indicate that a great deal of recombination between races had taken place on the barberries, and the large number of races is substantial evidence that the rust originated locally on these bushes. Of these 14 races, the only ones found commonly elsewhere are 56, 17, and 38. These were by far the most prevalent in the Mississippi Valley, but each was isolated only once in the material from the Palouse area. It appears, therefore, that there was relatively little interchange of rust, if any, between this area and other wheat-growing areas in which the prevalence of physiologic races is known.

Applications for permits to ship Berberis and Mahonia plants under the provisions of Federal Quarantine No. 38 were received from 42 nurseries during 1943 and 37 were granted. It was necessary to refuse 2 applications from outside the eradication states because the nurseries were growing susceptible barberries and did not wish to remove them, and the approval of 3 applications was delayed pending the eradication of susceptible plants. The inspection of nurseries has resulted in the almost complete elimination of susceptible barberry plants from nurseries in the states cooperating in the barberry eradication program. Also many nurseries outside the control area are

restricting their barberry stock to immune or resistant varieties and species. During the year 700 susceptible barberry plants were destroyed in 17 of these nurseries by cooperating owners.

Serious stem rust losses to grain in the Palouse area of the State of Washington in 5 out of the last 7 years brought about the beginning of barberry eradication in that area. These losses were particularly severe in Whitman County, which is the leading wheat producing county, not only in Washington, but also in the United States. The farmers decided to reduce these losses and, in cooperation with county officials and the State Department of Agriculture, started the eradication of barberries in the fall of 1943. The work was begun on a small scale in Whitman County, which has an active weed-control organization, and later the State Department of Agriculture requested federal assistance in the eradication of barberries within the grain-growing areas of the State. This request was made too late for the Department to include an estimate for it in the regular budget for the fiscal year 1945. The State, through its representatives, then requested Congress to increase the barberry eradication item by \$25,000 in order that Washington might receive assistance similar to that provided other states already participating in the cooperative program for the control of stem rust. Congress approved this request and made the funds available in the appropriation item for barberry eradication for the fiscal year 1945.

Barberry Eradication

Table 1 - Accomplishments in Barberry Eradication During the Calendar Year 1943

State	Area		Properties Cleared		Bushes Destroyed		
	Surveyed	Sq. Miles	New	Old	Berberis: Native		Total
					vulgaris: species*	Number	
			Number	Number	Number	Number	Number
Colorado	124		46	186	11,360	273,110	284,470
Illinois	493		32	53	816	- -	816
Indiana	682		9	36	796	317	1,113
Iowa	592		56	123	2,714	125	2,839
Michigan	906		194	239	5,623	- -	5,623
Minnesota	198		35	97	742	- -	742
Montana	863		2	5	148	- -	148
Nebraska	297		1	8	35	- -	35
North Dakota	641		0	1	27	- -	27
Ohio	177		37	178	6,122	- -	6,122
South Dakota	113		1	1	5	- -	5
Wisconsin	203		81	339	7,764	- -	7,764
Wyoming	-		-	-	-	- -	- -
Sub-Totals	5,289		494	1,266	36,152	273,552	309,704
Missouri	73		8	26	197	- -	197
Pennsylvania	27		25	121	207,656	- -	207,656
Virginia	18		17	34	16,155,875	1,155,891	1,155,891
West Virginia	49		0	141	41	42,444	42,485
Sub-Totals	167		50	322	207,910	1,198,319	1,406,229
GRAND TOTALS	5,456		544	1,588	244,062	1,471,871	1,715,933

*B. fendleri and B. canadensis

Barberry Eradication

Table 2 - Status of Barberry Eradication through 1943

State	Square Miles			No. of Properties with Barberries		
	In Control Area	On Main-tenance	Unworked or Requiring Rework	Cleared to Date	On Main-tenance	Requiring Rework
Colorado	68,594	63,940	4,654	2,703	1,273	1,430
Illinois	56,043	24,583	31,460	19,523	6,003	13,520
Indiana	36,045	26,049	9,996	6,882	4,494	2,388
Iowa	56,167	30,432	25,735	15,149	5,412	9,737
Michigan	57,481	37,699	19,782	17,165	8,256	8,909
Minnesota	80,883	26,480	54,403	8,825	4,384	4,441
Montana	146,316	126,048	20,268	637	298	339
Nebraska	77,268	62,839	14,429	4,797	2,199	2,598
North Dakota	70,183	64,329	5,854	1,074	833	241
Ohio	40,740	18,920	21,820	16,956	4,828	12,128
South Dakota	76,868	71,629	5,239	1,494	1,140	354
Wisconsin	54,852	12,848	42,004	16,889	3,521	13,368
Wyoming	94,487	94,371	116	125	50	75
Sub-Total	915,927	660,167	255,760	112,219	42,691	69,528
Missouri	37,570	20,465	17,105	1,346	255	1,091
Pennsylvania	27,073	4,261	22,812	8,677	-	8,677
Virginia	11,821	1,418	10,403	3,803	2	3,801
Washington	25,769	-	25,769	Work initiated July 1944		
West Virginia	14,295	9,785	4,510	2,026	-	2,026
Sub-Total	116,528	35,929	80,599	15,852	257	15,595
GRAND TOTAL	1,032,455	696,096	336,359	128,071	42,948	85,123

9. Pink bollworm and Thurberia weevil control:

Inspection to determine status and possible presence of the pink bollworm and Thurberia weevil within and without regulated areas: Inspections of the 1943 cotton crop for pink bollworm were made in Florida, Georgia, Alabama, Mississippi, Louisiana, Texas, New Mexico, Arizona and California. The bulk of this work consisted of gin trash inspection, but it was extensively supplemented by inspection of cotton bolls in the field and laboratory. Some 92,000 bushels of gin trash were inspected during the year.

Outside of the quarantined area new infestations of the pink bollworm were discovered in Brazoria, Calhoun, Matagorda and Schleicher Counties, Texas; and Calcasieu, Cameron and Jefferson Davis Parishes of Louisiana, as a result of gin trash inspection. The new infestation in Schleicher County in west-central Texas is probably not of great importance since it adjoins an area which has been infested for a number of years. The newly infested districts along the Gulf Coast in Texas and Louisiana constitute a very serious danger to further spread to important cotton-producing sections unless promptly checked. For this reason, intensive gin trash inspections were made in the area involved and in adjacent areas to delimit insofar as possible the new infestation. This involved examination of 10,070 bushels of trash on the Texas Gulf Coast and 1,873 bushels in southwestern Louisiana. In addition, intensive field inspections were made along the coast of both states where conditions were not suitable for gin trash inspection.

Within the regulated area inspection of the 1943 cotton crop showed a further increase in degree of infestation in Cameron, Hidalgo, Maverick, Hudspeth and El Paso Counties and a more widely distributed infestation in other counties of South Texas except in Webb and Live Oaks Counties, where results were negative. Only one county--Tom Green--was found infested in the Panhandle quarantined area of Texas, and as a result of negative inspections which have continued over a number of years. Lamb, Bailey, Hockley and Cochran Counties, Texas and Roosevelt County, New Mexico, which adjoins this area, were released from quarantine. The regulated areas in Arizona and New Mexico continued to show a light infestation, with some shifts in infested localities.

Regulatory operations to suppress and prevent spread of the pink bollworm and Thurberia weevil as required by Federal quarantines on these insects: The objective of this project is to prevent the artificial spread of the pink bollworm and Thurberia weevil to new areas, prevent build-up in known infested areas by the supervision of processing plants, and to issue permits authorizing the movement of cotton and cotton products from regulated to free areas. To accomplish this objective, cotton and its products must be treated in such a manner as to kill any pink bollworm and Thurberia weevil

that might be present, and kept free from contamination after such treatment. Cotton and products so treated and handled are then considered safe for movement into the channels of interstate commerce and are certified to authorize movement. This conditioning and certification requires a great deal of supervision of a large number of processing plants and individuals engaged in ginning cotton and processing cotton products and operate under dealer-carrier permit. Supervision is likewise necessary subsequent to treatment to prevent contamination with untreated material which might result in reinfestation of the treated products. Due to the feeding habits of the pink bollworm larvae, a principal means of artificial dissemination is through movements of cottonseed. Consequently, prior to certification of that product and as a part of the ginning process the seed must be heated to 150° F. to kill any pink bollworm therein. Supervision is also given compression and roller treatment of cotton lint and linters, which must be produced and subsequently handled under sanitary conditions at gins and other processing plants. Gin trash and other debris must be treated or burned in order to kill all pink bollworm therein and to prevent favorable places of hibernation at concentration points.

The discovery of infestation in the Gulf Coast Counties of Calhoun, Brazoria, and Matagorda in Texas and in the three southwestern Parishes of Cameron, Calcasieu and Jefferson Davis in Louisiana during the growing season of 1943 created a serious threat of spread of the pink bollworm throughout the entire cotton belt as these areas were not then applying safeguards to prevent artificial spread. Since the infestation was found so late in the season, it was not possible to install cottonseed heating equipment in the gins at that time. The new areas were promptly placed under emergency quarantine by the respective states involved and all cotton produced after discovery of the pink bollworm was ginned within the area. Cottonseed moved to designated mills only and was treated by heat upon arrival. Cotton moved under permit to designated compresses for treatment upon arrival. Other regulatory procedure in these newly infested areas was administered as effectively and efficiently as would have been possible under a permanent quarantine. Gins located within the newly infested area installed suitable cottonseed heating equipment to treat all seed produced during the 1944 crop as a continuous process of ginning. Incinerators were erected to burn all gin trash and debris, or other arrangements made for the treatment of such material so as to kill any pink bollworm that might be present.

During the season of 1943-44, 874,175 bales of cotton were ginned at 555 gins located within the area regulated on account of the pink bollworm and under direct supervision of inspectors of this project. Three hundred nineteen thousand, nine hundred eighty-nine (319,989) tons of cottonseed were treated by heat to render them free of

pink bollworms. Careful inspections and supervision of heat treatment of cottonseed in heavily infested areas indicated continued efficiency, so that it was possible to permit movement of linters produced from such seed without any additional treatment. Educational work of supervising inspectors in regulated areas, together with thousands of germination tests of treated cottonseed, has virtually eliminated any objection of the growers to the planting of treated seed. Forty-nine (49) oil mills were under dealer-carrier permit and were given close supervision. At 11 cotton compresses 505,887 bales of cotton and 8,580 bales of linters were given compression under dealer-carrier permit. Installations of gin trash screening devices to remove sand, which were suggested and developed by regulatory inspectors, have resulted in marked improvement in sanitary requirements at many of the gins in the Panhandle district of Texas. Considerable progress was made in the design and erection of incinerators to burn gin trash and other debris. A total of 23,606 inspections were made of plants and premises of cotton processors in the regulated areas under dealer-carrier permit.

Cotton and cottonseed furnish fiber and food. Products thereof are converted into numerous materials vitally necessary in the prosecution of the war. The treatment and certification of cotton and cotton products permits the expeditious movement of these vital commodities into the regular channels of trade without endangering the cotton production by the spread of this pest. Although there has been some spread of the pink bollworm during the past year, all of the evidence indicates that such spread was by natural means through migration of the adults and in no instance has evidence indicated that the newly discovered infestations resulted from the artificial movement of products.

Due to the absence of infestation for a number of years in that part of Lamb and Bailey Counties in Texas under quarantine, as well as Hockley and Cochran Counties in Texas, and Roosevelt in New Mexico, it was considered safe to release this territory from quarantine. Accordingly, Quarantine 52 was amended, effective May 1, 1944, whereby these counties were released.

Control operations for suppression and eradication of infestations of the pink bollworm: In delimiting the infestation found by inspections of gin trash from gins in Cameron, Calcasieu and Jefferson Davis Parishes, Louisiana, a heavy infestation was found in fields in Cameron Parish. It was apparent that unless drastic measures were taken the insect would become well established and probably spread rapidly to additional areas by natural means. The Bureau cooperated with the State of Louisiana and the farmers in carrying out a very intensive cotton field cleanup which involved cutting, piling and burning of the stalks and shattered cotton bolls. The most effective pink bollworm control procedure known is the creation of a cotton-free area,

commonly referred to as a "non-cotton zone." Several meetings were held with the growers of Cameron Parish and well in advance of the planting season the State of Louisiana declared that the majority of that parish, together with a limited portion of Calcasieu Parish, would be a non-cotton zone for the crop season of 1944. The order requiring non-production of cotton in this area was completely complied with during the 1944 cotton planting period and intensive surveys failed to reveal any volunteer cotton in the area. Infestation was not found in cotton fields of remaining part of Calcasieu and of Jefferson Davis Parishes and these areas were not included in the non-cotton zone. In compliance with a State of Louisiana regulation the fields were cleaned by cotton growers following the harvesting of 1943 and the stalk destruction by the farmers following the 1944 harvest, which is required under State regulation.

For the crop year 1943 the control program in the Big Bend of Texas was modified from the practice followed in preceding seasons. The change called for early planting, coupled with early cotton field cleanup in the fall. Weather conditions, shortage of labor and other factors prevented the carrying out of the revised program, and the infestation in this section increased. Since it was not practical to carry out this revised program the State of Texas returned to a delayed planting of cotton requirement for the 1944 crop. Planting was prohibited prior to April 24. Early inspections in that area indicate a light initial infestation for the present crop. The advantages of applying additional suppressive measures in the Big Bend of Texas to the overall program of pink bollworm control are apparently reflected in a reduction in infestation in the Panhandle of Texas. A large portion of the Panhandle has been free of infestation for several years and, as indicated above, it was possible to release several counties from quarantine.

The pink bollworm control program in the Lower Rio Grande Valley of Texas and Mexico involves prompt destruction of cotton stalks, following the harvesting of the crop and at least prior to a specified date established by State regulation in Texas and by competent authority in Mexico. There was a substantial buildup of pink bollworm infestation, in the 1943 cotton crop in the vicinity of San Benito, Cameron County, Texas. This area represented an extension of the area previously known to be rather heavily infested and was not a part of the section where cleanup was required by State regulation. The growers in this area of the Lower Rio Grande Valley became visibly concerned and the farmers voluntarily - without being required by State regulation - cut the cotton stalks and raked them into piles for burning. In these fields showing heavy infestation, the Bureau cooperated with the State and local growers by going into the fields, collecting the shattered material, placing it upon the piles of stalks and burning the whole lot. The effect of this intensive cleanup in a limited area was reflected in the population detected in the inspection of the 1944 crop. Many of these fields which were heavily infested in

1943 show negative. Unfortunately, however, infestation was found in other fields of this same area again and in other areas. Early season inspections indicate that the initial pink bollworm infestation of the 1944 crop is higher and more widespread than in any previous year in the Lower Rio Grande Valley. The outlook is not bright. The State of Texas has established September 15 as the deadline for cotton stalk destruction in 1944. It is expected that all possible emphasis will be placed upon prompt plowing under of the destroyed cotton stalks and debris.

Attention has been focused upon control of the pink bollworm in the Glendale, Arizona, area for several years and it now appears that the several annual cotton field cleanups, coupled with deep plowing, have resulted in eradication of the insect from that portion of the Salt River Valley - so no control program was required by state regulation following the harvesting of the 1943 crop. The farmers, however, were urged to continue the same cultural practices involving deep plowing which they had been following.

Eradication of wild cotton in Florida for protection of the cultivated cotton from the pink bollworm: Although difficulties were encountered in operating under wartime conditions and with a shortage of labor, especially in the Cape Sable area - which is by far the largest in wild cotton acreage - there was an easing of the situation as compared to 1943. More than twice as many acres were cleaned and recleaned this year as during the preceding year and it was possible to work approximately 2,000 additional man-days.

The first cleanup for the season was completed early in most sections and particularly at Cape Sable, where approximately 80 percent of the total number of mature plants and 67 percent of the seedlings were removed. A large number of plants were destroyed before they reached the fruiting stage. However, there were many mature and open bolls, most of which were collected and destroyed before they had fallen to the ground. Most of the wild cotton locations on the west coast were covered three times. Special attention was given to that portion of the wild cotton area north of Naples in which a barrier zone has been created between extensive growths of wild cotton and the domestic cotton plantings now extending southward in Florida almost to Tampa. No pink bollworms were found in this section during the current season, and every effort will be made to maintain this status. Two complete cleanings were made of the Cape Sable area, except that part of the area in which very little wild cotton is present. All locations on the Keys were covered twice and some were covered three times.

A total of 326,944 plants were destroyed, bringing the total number of wild cotton plants destroyed since the inception of this work to 16,429,671. Of the season's total 29,425 plants had mature bolls and

297,519 were small seedlings. This was a decrease of nearly 10,000 plants with mature bolls, as compared to the 1943 season, and an increase of more than 100,000 young seedlings. The larger number of seedlings is due partially to the availability or increase in manpower, making more adequate and efficient coverage possible in some areas, and partially to moisture conditions.

During the past season inspection of 35,253 forms taken from wild cotton plants yielded only 263 pink bollworms. During the early years of this work infestation was as high as 40 percent in some sections.

Cooperation with the Mexican Government to control pink bollworm infestation to prevent spread into the United States: In order to secure the most effective possible cooperation with the Mexican Department of Agriculture and local agencies in carrying on more extensive and comprehensive operations in connection with the suppression of the pink bollworm in the Mexican areas which at the present time constitute the gravest risk of spread into the United States by natural means, the work project responsible for this activity was considerably expanded during the fiscal year 1944. This expansion involved placing highly trained, technical employees of the Bureau in Mexico in not only the areas immediately adjacent to the border, but in the great cotton-growing region of interior Mexico in the vicinity of Torreon, Coah. Advancement along this line was the objective of the personnel operating in Mexico during the past season. The past year has been used by the representatives of the Bureau at interior points in Mexico to lay the groundwork for securing effective compliance of the pink bollworm requirements of the Mexican government which have as their objective suppression of the pest. Many contacts have been established with those who are in a position to bring about a satisfactory control program in Mexico, including officials and organizations concerned with cotton production, processing, marketing and shipping. It is planned through these and additional contacts to develop and standardize the application of control operations into unified cooperative efforts between the two countries. Control programs are now in effect in all infested cotton-growing areas in Mexico, varying in procedure according to the needs of the area under consideration. In the Matamoros district of Tamaulipas, opposite the Lower Rio Grande Valley of Texas, farmers are required by regulation to destroy their cotton stalks following the harvest of the crop. Such a stalk destruction program was carried out on approximately 200,000 acres by the farmers themselves. In general, in other areas of Mexico the procedure followed is similar to control practiced in the United States, although in some areas - particularly in the interior - other insect problems causing a lack of interest in pink bollworm control have not been conducive to accomplishment of the best results. An objective of this project is to arouse the interest of the growers, processors, and other cotton factors in order to secure more active participation in pink bollworm control.

10. Transit inspection:

As a direct result of food rationing and of requirements of farmers and gardeners to fulfill the greatly increased demands for food production occasioned by the war, there has been a large increase in the interstate shipping of vegetable plants, fruit trees, small fruit bushes, and other commodities, the movement of which is regulated by various plant quarantines. This increase was particularly noticeable during the spring of 1944.

The number of shipments of restricted materials examined by transit inspectors increased nearly 18 percent over the number examined the previous year to a total of 2,701,323. A considerable part of these shipments consisted of citrus fruit moved from the area quarantined on account of the Mexican fruitfly. As an aid to enforcing the provisions of this quarantine and in preventing the possible dissemination of this destructive fruitfly to other fruit-growing areas, transit inspectors were stationed at gateways through which shipments from the Rio Grande valley pass. A total of 337 shipments of unsterilized fruit were intercepted.

During the year 2,290 apparent violations of 7 of the 9 Federal Domestic Plant Quarantines were reported. This was an increase of 77 percent over the number of violations of the previous year. In addition, 38 violations of the plant-shipping regulations of the District of Columbia were found and 608 apparent violations of state plant quarantines and nursery inspection regulations were reported to states concerned. Transit inspection was conducted during the fiscal year 1944 at 18 of the more important terminal and transfer points for mail, express, and freight. The cooperation of State pest control and transportation agencies, as in the past, was a very considerable aid to the effectiveness of this activity.

Shifts in population caused by concentration of workers in industrial centers and military personnel at training centers and changes in quarantined areas and regulations have affected to some extent the amount, direction, and distance of movement of regulated articles. These are some factors considered in appraising the relative importance of the movement of regulated articles with respect to hazard of pest distribution. These war time conditions have made it necessary frequently to review the importance of stations with respect to quarantine enforcement and make adjustments in personnel accordingly. The movement of a majority of articles regulated by plant quarantines is of a seasonal nature. It has, therefore, been possible to adjust personnel assigned to this work so as to release some trained inspectors to help relieve the manpower shortage on other activities without seriously interfering with the work. This practice followed during the emergency has meant that not all stations were protected throughout the year, but it has been possible to employ additional inspectors during the periods of greatest activity and when the risk is the greatest. This wartime adjustment of personnel has a bearing on comparative analysis of the work at various stations where it is desirable that inspectors be present throughout the year. Considerable assistance is given this activity by a number of states and funds were used from several of the subappropriations in the current Act to employ inspectors to assist during the seasons of greatest activity.

The program for the current year contemplates the following features:

(1) The continued careful appraisal of the importance of stations with respect to enforcement of the several quarantines and relative hazard of pest dissemination to agriculture in type of shipments seen or intercepted at each station so that emphasis may be shifted to points where the greatest good may be accomplished by available funds and personnel. This may require the closing of some present stations and opening of new ones, depending upon circumstances that may develop.

(2) Study of car-lot interchange centers with respect to movement of refrigerator cars of fruit and vegetables from heavily infested Japanese beetle areas and concentration of inspection at those points during the summer months to prevent, insofar as possible, the movement of uncertified shipments to points outside the regulated areas. (3) Continued encouragement of cooperation of thousands of mail, express, and freight employees and their education with respect to quarantine requirements and restrictions. Such employees are a valuable factor in transit inspections as they watch for and find shipments suspected of moving in violation of plant quarantines, many of which would not be seen by inspectors in the course of their normal inspection tours. The employment of many new employees by these agencies due to the war emergency makes it particularly necessary to maintain contacts with them in order that they may all be kept advised as to the purpose of the work and the ways in which they may be of assistance.

(e) Foreign Plant Quarantines

Appropriation Act, 1945	\$797,700
First Supplemental Appropriation Act, 1945	+102,000
Proposed transfer in 1946 estimates from:	
General administrative expenses	+23,000
Certification of exports	+34,480
Total available, 1945	957,180
Budget estimate, 1946	1,027,000
Change for 1946:	
Overtime decrease	-137,073
Increase	+206,893
	<u>+69,820</u>

PROJECT STATEMENT

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
1. Import and permit service	\$27,760	\$26,100	\$26,100	- -
2. Inspection at ports of entry of plants and plant products regulated by plant quarantines	663,524	763,727	970,620	+\$206,893(1)
3. Certification of exports	30,000	30,280	30,280	- -
4. Overtime costs	119,694	137,073	- -	-137,073
Unobligated balance	19,047	- -	- -	- -
Total estimate or appropriation	860,025	957,180	1,027,000	+69,820

INCREASES OR DECREASES

The increase of \$69,820 in this item for 1946 consists of \$137,073 decrease for overtime, and the following:

- (1) An increase of \$206,893 under the project "Inspection at ports of entry of plants and plant products regulated by plant quarantines" to provide the minimum essential plant-quarantine safeguards against entry of foreign plant pests (a supplemental appropriation of \$102,000 to meet the increased work load in the current year was provided in the First Supplemental Appropriation Act, 1945):

Objective: To provide plant-quarantine inspection to cover current greatly expanded commerce.

The Problem: The problem divides itself naturally into three phases:

- (1) The expansion of plane transportation resulting from the war, with the corresponding increase in pest risk, emphasized by the speed with which a plant pest can be transported by this means, has been studied to appraise the need for plant-quarantine inspection service. Planes arrive at airports in this country in a continual flow which only hours before took off from many different foreign countries. Serious insect pests

have been found in the planes or in the belongings of passengers or crew or in its cargo. Staffs of inspectors at airports must be able to meet all of the planes which arrive at all hours of the day and night.

(2) The expedition overseas of millions of men and women as members of the armed forces has resulted in the receipt of a huge volume of parcel post from such personnel and, as the strength of our armies abroad increases, so does the mail from them. This mail enjoys the unique postal and customs privileges which places it in a class apart from peacetime international mail, thus creating problems in providing plant-quarantine coverage in addition to the problems arising from its volume. Studies of these problems were made in 1944 under an allocation from the Emergency Fund for the President which indicated the potential pest risk with the service mail and the importance of providing plant-quarantine inspection at mail centers to cope with the current rapidly increasing volume of foreign parcel post. This important plant pest protection service should be available in 1946 and as long as this abnormal flow of mail continues.

(3) The dispatch of millions of soldiers, sailors, and marines overseas, the supply requirements of our allies, and the necessity for feeding liberated peoples have brought about such a rapid expansion of wartime commerce that existing personnel is unable to keep pace with the demands for plant pest protection of the carriers and cargoes arriving in increasingly greater volumes to meet this Nation's requirements for domestic consumption and overseas commitments. Studies indicate that the plant-quarantine service provided for the last half of the current fiscal year must be maintained and that requirements for this service will likely increase for the duration of the war and probably will continue for some time thereafter.

Significance: There are thousands of known destructive plant pests in foreign countries which do not exist in this country. They may gain entry and become established by means of carriers, either air or surface borne, cargoes, supplies, equipment, baggage and mail arriving from their native habitats. The risk of entry increases with the volume of traffic. This volume has suddenly increased due to wartime conditions beyond all peacetime peaks presenting pest protection problems which cannot be met with existing staffs and facilities. As a result there are unguarded avenues for the entry of pests inimical to American agriculture and which, if established could jeopardize the Nation's ability to meet production goals for vital food, feed, and essential fibre crops. The importance of applying adequate plant quarantine protection is amply illustrated by the annual losses from foreign pests which have already gained entry, such as the Japanese beetle, the cotton boll weevil, the European corn borer, and the white pine blister rust, to mention a few.

Plan of Work: With the requested increase it would be possible to continue the program of protection from foreign plant pests which it is planned to initiate in 1945, and thus continue the plant quarantine inspection service at several airports and interior postal centers where this service is not now available as well as continue the employment of trained inspectors at other ports where increased traffic requires their services. The manpower

situation has been considered in connection with this program and it is believed that the Civil Service can supply sufficient applicants with the required educational background from discharged service personnel, and normal recruiting, including women eligibles where their services can be used.

Financial Requirements: The technical nature of this activity requires workers trained in entomology and plant pathology primarily, with some additional clerical assistance. The program for 1946 is estimated to require an additional \$206,893, a requirement that will continue as long as comparable conditions exist.

CHANGES IN LANGUAGE

The estimates propose the following language for this item (new language underscored, deleted matter enclosed with brackets):

Foreign plant quarantines: For operations against the introduction of insect pests or plant diseases into the United States, including the enforcement of foreign plant quarantines[, at the port of entry and port of export, and to prevent the movement of cotton and cottonseed from Mexico into the United States, including the regulation of the entry into the United States of railway cars and other vehicles, and freight, express, baggage, or other materials from Mexico, and the inspection, cleaning, and disinfection thereof, including construction and repair of necessary buildings, plants, and equipment, for the fumigation, disinfection, or cleaning of products, railway cars, or other vehicles entering the United States from Mexico, \$797,700: Provided, That any moneys received in payment of charges fixed by the Secretary on account of such cleaning and disinfection shall be covered into the Treasury as miscellaneous receipts] and regulations promulgated under sections 5 and 7 of the Plant Quarantine Act of August 20, 1912, as amended (7 U.S.C. 151-167), the Insect Pest Act of 1905 (7 U.S.C. 141-144), and the Mexican Border Act of 1942 (7 U.S.C. 149), for enforcement of domestic plant quarantines as they pertain to territories of the United States and enforcement of regulations governing the movement of plants into and from the District of Columbia promulgated under section 15 of the Plant Quarantine Act of August 20, 1912, as amended, and for inspection and certification of plants and plant products to meet the sanitary requirements of foreign countries, as authorized in section 102 of the Department of Agriculture Organic Act of 1944 (Public Law 425), \$1,027,000.

This item represents a consolidation of the items now carried for Foreign Plant Quarantines and Certification of Exports and a pro rate part of the item for General Administrative Expenses.

The appropriation language recommended for "Foreign Plant Quarantines" and the language recommended for the preamble are intended to provide the same authorizations and provisions for the regulatory work involved as were provided by the 1945 Agricultural Appropriation Act.

WORK UNDER THIS APPROPRIATION

Objective: To protect agriculture by administering plant quarantines and regulatory orders; issued under the Insect Pest Act of 1905, the Plant Quarantine Act of 1912, as amended, and the Mexican Border Act of 1942, to prevent the entry of insect pests and plant diseases from foreign countries, Puerto Rico and Hawaii and control and safeguard the entry of plants, plant products and other articles which may carry such pests.

The Problem and its Significance: The estimated average annual loss from introduced foreign insect pests of plants and plant products is \$1,500,000,000. This figure does not include huge annual losses from introduced fungous, bacterial, and virus diseases of plants. It is vital that every possible effort be made to prevent the introduction and establishment of additional foreign plant pests which could impede the war effort through reduction of food supplies and essential crops.

World commerce has been completely changed by the war, and current conditions impose new problems of foreign plant quarantine enforcement through the substitution, for normal commercial shipping, of abnormal wartime shipping and the movement of the ships and aircraft, troops, and supplies, of the armed forces. The exigencies of the latter movements create a set of problems peculiar to the situation which necessitate intensive supervision of the personnel and work, and constant adjustment of emphasis to meet the changes occurring from day to day.

Receipts: During the fiscal year 1944 receipts of \$46,708 resulted from the fee of \$4.00 a car charged for fumigating railroad cars entering this country from Mexico. This fumigation is required as a safeguard against the introduction of insects attacking cotton. Estimated receipts from this source in 1945 are \$50,000.

General Plan: Under the Plant Quarantine Act most kinds of plant propagating materials, fruits, vegetables, cotton lint and related products, cereals, etc., may be imported only under permit, subject to inspection, and in some instances supervised disinfection, sterilization, etc., at the ports of entry. In Hawaii and Puerto Rico the movement of certain plants and plant products to the mainland is supervised, and certain products are treated under supervision for the prevention of the movement of injurious pests with these products. The work is organized under two general headings (a) Import and Permit, and (b) Port Inspection, and is conducted at a cost of less than 1/2000 of the estimated annual loss from introduced insect pests, which does not include loss from introduced plant diseases.

During the fiscal year 1945, cooperation from States and territories will amount to \$197,746, the major contribution being from California and Florida.

Examples of Progress and Current Program:

1. Import and permit service: Conditions arising out of the war have made it necessary to arrange on short notice for emergency entry of various cargoes, and the special arrangements include the minimum essential phytosanitary safeguards which frequently require unusual methods of handling, treatment, and routing. The millions of Americans now overseas in the armed forces include plant lovers and others interested in plants who write to inquire regarding the plant quarantine regulations and procedures for importing. This unusual load of correspondence, directly resulting from the war, immediately affects any savings which may have been made through economies in the permit procedures. Under this project and associated with the actual issuance of permits is a considerable amount of necessary correspondence with the importing public and plant quarantine inspectors located at the ports of entry. This correspondence is concerned with the entry status of proposed importations and the plant quarantine entry requirements to be met.

Studies completed in 1944 have resulted in simplification of permit procedures and have speeded up plant quarantine clearance of importations of restricted plants and plant products upon their arrival in this country. Changes made have been of benefit to those concerned in the importation of plant materials as some paper work and record work have been eliminated. To expedite entry and reduce correspondence to the minimum, provision has been made for the issuance, under emergency conditions of certain types of permits at the ports of entry in connection with work performed under the project "Inspection at Ports of Entry."

2. Inspection at ports of entry:

Airplane inspection: Safeguarding against the risk of entry of injurious foreign insect pests and plant diseases with airplanes arriving from abroad, and against the spread of destructive plant pests from Hawaii and Puerto Rico to the mainland by means of airplanes, developed into a major problem in 1944, which will continue to be of increasing importance in the years to come. Inspection of airplanes from foreign countries increased 65 percent over 1943. There was an increase of over 600 percent in the inspection of airplanes enroute from Hawaii to the mainland. The total of 23,833 airplanes inspected in 1944 was 10,466 greater than in 1943 and over three times the total for 1941 which indicates the rapid growth of the problem. It was physically impossible, with the personnel available, to inspect all airplane arrivals from foreign countries, many of which are regularly arriving, on around-the-clock schedules, at fields distant from maritime ports of entry. This necessitated an intensive study of the problem and working out improved cooperation with the Army and Navy designed to prevent the transmission of potential pest-carrying materials to this country by airplanes. Meanwhile, personnel was assigned to this activity at the expense of work at maritime ports of entry. Additional inspectors, with proper educational qualifications, are now being recruited and trained for assignment to this work with particular emphasis

on airports not previously receiving plant quarantine protection. At the request of the Army, airplanes departing from Hawaii for the mainland are now inspected before taking off, thus obviating inspection on the mainland with the resulting delay to important passengers and cargoes.

The importance of airplane inspection, which is carried on at maritime, Canadian and Mexican Border ports, and in Hawaii and Puerto Rico, is illustrated by the finding of potential pest-bearing plant material on 3,031 airplanes arriving from foreign countries in 1944. This impressive figure was accumulated despite the efforts of Military, Naval, and civilian agencies to prevent carrying such material on these airplanes. Among the pernicious plant pests found in this material were the Mediterranean fruitfly, the Mexican fruitfly, citrus blackfly, and the West Indian bean-pod borer. In addition, serious plant pests of Hawaii were frequently prevented from moving from Hawaii to the mainland through the pre-flight inspection program.

Mail from military and naval personnel abroad: A new problem in plant quarantine enforcement that rapidly expanded in 1944 consists of the plant quarantine control over mail from the millions of Americans in uniform now stationed in foreign countries. They enjoy unique customs and postal privileges which place their mail in a class apart from regular mail from foreign countries. Regular mail is examined sufficiently to insure that practically all packages containing potential pest-carrying plant material are referred for plant quarantine inspection. This assurance is lacking for mail from service personnel. Only a very small part of it receives customs examination sufficient to determine whether it may contain prohibited plant material, consequently vast quantities of this class of packages moved through to destination without plant quarantine protection because of a lack of plant quarantine inspectors to examine it. The personnel available to examine mail in 1944 for plant quarantine purposes inspected only 147,007 packages but this was an increase of 97 percent over 1943. Among the pests found in the limited number of packages examined was the pink bollworm of cotton. This pest was taken on several occasions in mail from various countries which in some instances was addressed to the cotton growing areas of the South. Another pest taken was the olive fly, a destructive pest of olives not known to occur in this country. Personnel is being recruited and trained for assignment to several postal-customs mail centers in the interior of the country which are now handling up to twelve times the volume of packages received during the pre-war years. Meanwhile, officials of the Army and Navy postal services are alert to the seriousness of this problem and are cooperating in the efforts to reduce the risk of pest entry through the issuance of orders to uniformed personnel against the inclusion of prohibited plant material in mail from abroad. The inspection of mail from members of the armed forces abroad is a part of the activities associated with all of the established work projects. The greater volume is associated with work at maritime and Canadian Border ports although inspections in Hawaii help to reduce the load at other ports and also the pest risk.

Enforcement of the Mexican Border Act: During wartime the regulation, inspection, and fumigation, when necessary, of freight cars crossing into the United States from Mexico, as provided by the Mexican Border Act, as a plant quarantine function assumes even greater importance, and part of the operations carried on under the work project dealing with inspections at Mexican Border Ports. The problem is to prevent the entry of serious plant pests without unduly impeding traffic. The number of freight cars inspected in 1944 was 67,755, a decrease of 1,429 from 1943, but the number which required fumigation as a condition of entry increased by 843 to a total of 12,985. This is more than four times the number fumigated in the pre-war year 1940. Freight car congestion in the yards on both sides of the Border at the several railroad crossings is a material concern to the operating personnel, the procurement officers, and other officials of agencies charged with the traffic in supplies and raw materials between the two countries. Plant quarantine inspectors are continuously working with representatives of other agencies to coordinate plant quarantine enforcement with traffic schedules to expedite the flow of freight cars from Mexico.

Meanwhile, every effort consistent with safety from pest risk is made to take advantage of operating and shipping practices for the reduction of the number of cars requiring fumigation in order to facilitate the flow of traffic from Mexico. As an example, arrangements were made in 1944 to receive promptly copies of the daily records of freight car interchange between the National Railways of Mexico and the Southern Pacific Railroad of Mexico, at Guadalajara, Jalisco, Mexico. These records, substantiated by other available information and by actual examination of northbound freight cars at Nogales, Arizona, make it possible to waive fumigation for a large number of cars that have not been off the Southern Pacific of Mexico and, hence, have not been in an area of Mexico where the pink bollworm of cotton occurs. This new procedure may be followed without increasing the pest risk for as long as the pink bollworm is absent from the area served by that railroad. The waiver of the fumigation requirement in these instances materially facilitates the flow of northbound freight traffic through Nogales.

Other related work performed in 1944 included the inspection of 4,620 Pullman and passenger coaches arriving from Mexico and 4,569,545 other vehicles. In cooperation with customs, 806,809 pieces of baggage were examined for prohibited plant material. In addition, it is estimated, millions of small lots of fruits and vegetables, purchased in Mexico for local consumption on the American side, were also inspected for plant pests. This required large outlays of inspector-hours, particularly at the larger ports. Among the economically important plant pests prevented from entering were a destructive potato weevil, a bean-pod borer which also attacks alfalfa, and two species of fruitflies.

Ship inspection: The wartime controls over shipping, particularly the convoy system and the measures employed by other agencies for security purposes, continued to place complicated problems in the way of effective plant quarantine protection at the maritime ports of entry during 1944. These controls and security measures frequently result in placing peak demands for plant quarantine inspection through the arrival of a large convoy while at the same time they increase the time required for this inspection to two and three times that which would be required under normal conditions. Ship inspections increased 39 percent in 1944 over 1943. A total of 26,981 were inspected out of 27,297 arrivals. One ship out of five was found to be carrying prohibited plant material, all of which is potentially a pest carrier. Among the pests found in this material were several species of fruit-flies and the West Indian bean-pod borer. In one instance 437 fruit-fly larvae were collected from 73 oranges. Many of these ships also carried dry ballast consisting in part of top soil, a favorite medium for pest introduction and there were large expenditures of inspector-hours to supervise the disposal of such ballast under adequate safeguards. Several destructive insects not recorded from this country were taken from the ballast. The disposal of garbage likely to present risk of spread of foreign plant pests was likewise a serious problem of 1944 requiring many inspector-hours to insure the best disposition possible under the circumstances. In one instance the inspector, stationed in a southern port, found 63 larvae of the Mexican fruitfly in garbage, principally in the juiced halves of oranges. The lively and rapidly expanding movement of ships in wartime commerce between Hawaii and the Pacific Coast is placing an increasingly heavy demand for plant quarantine protection against pest spread from Hawaii. Such notorious pests as the Mediterranean fruitfly, the melon fly, the bean-pod borer, and the pink bollworm of cotton are among those stopped in movement from Hawaii to the mainland by this activity. The work of ship inspection is part of the operations conducted at maritime ports and of the work projects dealing with work in Puerto Rico and Hawaii.

Cargo inspection: The rapid expansion of wartime commerce with carriers and cargoes arriving in this country in increasing numbers to meet this Nation's needs for home requirements and its commitments in supplying the great military and naval establishments of the Allies abroad, and in feeding liberated peoples, places an increased demand on existing personnel for plant pest protection at the ports.

During 1944 importations inspected for plant quarantine purposes included in round figures 10,300,000 containers and 17,400,000 lbs. of fruits and vegetables, and 30,300,000 bunches of bananas; 166,000 bales, 1,150,000 containers, and 37,600,000 lbs. of cotton lint, bagging, cottonseed meal and other cotton products; as well as large quantities of nursery stock, seeds, other fibres, cereals, etc.

Among the plant materials fumigated or otherwise safeguarded by treatment were 196,000 bales of cotton lint, linters, etc. and 30,500,000 lbs. of cottonseed cake and meal contaminated with uncrushed cottonseed.

Conditions arising out of the war resulted in the recurrence of arrivals of weevil-infested vetch-contaminated straw jackets around wine and liquor bottles. The insects infesting the seeds in this wild vetch are not known to occur in this country and are regarded as a serious potential hazard to the vetch cultures of the United States. While effective steps to correct the situation were being worked out, it was necessary to fumigate 240,000 cases of the imported beverages.

3. Certification of exports:

The following tabulation records the volume of work for the past two years:

	<u>1943</u>	<u>1944</u>
No. of certificates issued	1,824	1,716
No. of containers certified	514,718	594,306
No. of different commodities certified	42	40
No. of countries of destination	53	58
No. of ports of export	29	29

While the above tabulation indicates fewer certificates issued in 1944, there was an increase in the number of containers certified. A single certificate may cover a large number of containers with, for example, hundreds of small packages of different kinds of seeds. Inspection of such shipments may require much more time than a large shipment of apples or pears and is often complicated by the varying requirements of the country of destination for the different kinds of seeds.

Present indications point to increased use by the armed forces of the inspection and certification for export service under this project with respect to supplies for the armed forces in other countries, and by military and civilian agencies with respect to the aid to be given liberated peoples.

1. The first part of the report is a general introduction to the subject of the study. It discusses the importance of the study and the objectives of the research.

2. The second part of the report is a detailed description of the methodology used in the study. It includes information about the sample size, the data collection methods, and the statistical analysis techniques.

3. The third part of the report is a discussion of the results of the study. It presents the findings of the research and compares them with the previous studies in the field.

4. The fourth part of the report is a conclusion and a list of references. The conclusion summarizes the main findings of the study and provides recommendations for future research. The references list the sources of information used in the study.

5. The fifth part of the report is an appendix containing additional information related to the study. This may include raw data, detailed calculations, or other supporting materials.

6. The sixth part of the report is a bibliography listing the sources of information used in the study. This is a standard feature of academic reports and provides a way for readers to find the original sources of the information.

(f) Fruit Insects

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect investigations," as shown in the table on the first page of the Explanatory Notes for this bureau.

(g) Forest Insects

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect investigations," as shown in the table on the first page of the Explanatory Notes for this bureau.

(h) Truck Crop and Garden Insects

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect investigations," as shown in the table on the first page of the Explanatory Notes for this bureau.

(i) Cereal and Forage Insects

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect investigations," as shown in the table on the first page of the Explanatory Notes for this bureau.

(j) Cotton Insects

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect investigations," as shown in the table on the first page of the Explanatory Notes for this bureau.

(k) Bee Culture

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect investigations," as shown in the table on the first page of the Explanatory Notes for this bureau.

(l) Insects Affecting Man and Animals

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect investigations," as shown in the table on the first page of the Explanatory Notes for this bureau.

(m) Insect-pest Survey and Identification

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect investigations," as shown in the table on the first page of the Explanatory Notes for this bureau.

(n) Foreign Parasites

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect investigations," as shown in the table on the first page of the Explanatory Notes for this bureau.

(o) Control Investigations

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect investigations," as shown in the table on the first page of the Explanatory Notes for this bureau.

(p) Insecticide and Fungicide Investigations

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect investigations," as shown in the table on the first page of the Explanatory Notes for this bureau.

(q) Japanese Beetle Control

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect investigations," and "Insect and plant disease control" as shown in the table on the first page of the Explanatory Notes for this bureau.

(r) Sweetpotato Weevil Control

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect and plant disease control," as shown in the table on the first page of the Explanatory Notes for this bureau.

(s) Mexican Fruitfly Control

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect and plant disease control," as shown in the table on the first page of the Explanatory Notes for this bureau.

(t) Gypsy and Brown-tail Moth Control

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect and plant disease control," as shown in the table on the first page of the Explanatory Notes for this bureau.

(u) Dutch Elm Disease Control

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect investigations" and "Insect and plant disease control," as shown in the table on the first page of the Explanatory Notes for this bureau.

(v) Phony Peach and Peach Mosaic Eradication

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect and plant disease control," as shown in the table on the first page of the Explanatory Notes for this bureau.

(w) Barberry Eradication

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect and plant disease control," as shown in the table on the first page of the Explanatory Notes for this bureau.

(x) Pink Bollworm and Thurberia Weevil Control

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect and plant disease control," as shown in the table on the first page of the Explanatory Notes for this bureau.

(y) Transit Inspection

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Insect and plant disease control," as shown in the table on the first page of the Explanatory Notes for this bureau.

(z) Certification of Exports

Appropriation under the above title has been transferred to and estimated for in the 1946 estimates under "Foreign plant quarantines," as shown in the table on the first page of the Explanatory Notes for this bureau.

(aa) Special Research Fund, Department of Agriculture
(Allotment to Bureau of Entomology and Plant Quarantine)

This budget schedule covers obligations under an allotment for special entomological research projects dealing with the subjects bee products in relation to health and investigations of the properties of bee disease organisms and bee products.

(bb) White Pine Blister Rust Control, Department of Agriculture
(Bureau of Entomology and Plant Quarantine)

This budget schedule covers obligations under an appropriation (also involving the Forest Service and the Department of the Interior) for leadership, coordination, and technical direction of white pine blister rust control; blister rust quarantine enforcement, and cooperative blister rust control on State and privately owned lands.

(cc) Emergency Rubber Project, Department of Agriculture
(Allotment to Bureau of Entomology and Plant Quarantine)

This budget schedule covers obligations for entomological research and advice on guayule rubber.

(dd) Emergency Fund for the President, National Defense
(Allotment to Bureau of Entomology and Plant Quarantine)

This budget schedule covers obligations for the fiscal years 1944 and 1945 under a special allotment in connection with the prevention of insect pest infestations.

(ee) Working Funds (Bureau of Entomology and Plant Quarantine)

This budget schedule covers obligations under advances, pursuant to Section 601 of the Economy Act of June 30, 1932, for services performed for various agencies as shown in the following statement of obligations under supplemental funds.

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS
(1944 and 1945 figures include overtime costs)

Item	Obligations 1944	Estimated obligations, 1945	Estimated obligations, 1946
<u>Special Research Fund: Special ento-</u>			
mological research	\$15,330:	\$22,500:	\$19,723
<u>Allotment: Regular item for White</u>			
<u>Pine Blister Rust Control:</u>			
Leadership, coordination, and			
technical direction of white pine:			
blister rust control	513,936:	526,315:	551,840
Blister rust quarantine enforcement	11,664:	11,970:	9,980
Cooperative blister rust control			
on State and privately owned lands	285,796:	302,668:	1,470,180
Total, White pine blister rust			
control	811,396:	840,953:	2,032,000
<u>Emergency rubber project: Entomolo-</u>			
gical research and advice on			
guayule rubber	18,385:	20,000:	5,000
<u>Emergency fund for the President,</u>			
<u>National defense: Emergency insect</u>			
pest prevention	222,583:	268,500:	--
<u>Working Funds (Bureau of Entomology</u>			
<u>and Plant Quarantine) Advances from:</u>			
<u>War Department: Army Air Forces,</u>			
for control of the dog fly along			
Florida Gulf Coast in vicinity of:			
air training stations	150,088:	118,231:	--
<u>Commodity Credit Corporation: For</u>			
the conduct of investigations of			
methods of properly caring for			
grain in storage	11,039:	6,336:	--
<u>Office of Scientific Research and</u>			
<u>Development: For investigations</u>			
on methods of control for insects:			
affecting the armed forces	236,956:	428,258:	--
<u>Office of Coordinator of Inter-</u>			
<u>American Affairs: Assistance to</u>			
Mexico in biological warfare ...	761:	--:	--
Total, Working Funds	398,844:	552,825:	--
Total, Obligations under Supplemen-			
tal Funds	1,466,538:	1,704,778:	2,056,723

(ff) Control of Emergency Outbreaks of Insects and Plant Diseases

Appropriation Act, 1945	\$2,700,000
Budget estimate, 1946	<u>2,700,000</u>
Change for 1946:	

 Overtime decrease -223,700

 Offsetting increase to main-
 tain appropriation at ap-
 proximate annual average
 amount of past appropria-
 tions

+223,700

PROJECT STATEMENT

Project	1944	1945 :(estimated):	1946 :(estimated):
1. White fringed beetle control ...	\$761,625:	\$643,800:	- -
2. Pear psylla control	405,167:	411,500:	- -
3. Hall scale eradication	31,160:	33,400:	- -
4. Grasshopper and Mormon cricket control	947,168:	987,800:	- -
5. Armyworm control	- -:	15,000:	- -
6. Chinch bug control	147,287:	49,500:	- -
7. Mole cricket control	22,720:	44,100:	- -
8. Parlatoria chinensis survey	13,429:	- -:	- -
9. General surveys	106,969:	135,200:	- -
10. Overtime costs	231,026:	223,700:	- -
Reserve for future allotment	- -:	156,000:	- -
Unobligated balance	644,571:	- -:	- -
Total available	<u>3,311,122:</u>	<u>2,700,000:</u>	<u>2,700,000(1)</u>
Prior year appropriation available in 1944	<u>-3,311,122:</u>	- -:	- -
Total estimate or appropria- tion	- -:	<u>2,700,000:</u>	<u>2,700,000</u>

(1) It is not practicable to indicate with satisfactory accuracy a year in advance the amounts which may be required for specific projects, since the amounts to be allotted depend largely upon factors, including weather, that cannot be predicted.

CHANGES IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

Control of [Incipient and] Emergency Outbreaks of [Insect Pests] Insects and Plant Diseases

[Control of incipient and emergency outbreaks of insect pests and plant diseases:] To enable the Secretary to carry out the provisions of and for expenditures authorized by the joint resolution approved May 9, 1938 (7 U. S. C. 148-148e), including the purchase of not to exceed three airplanes, and surveys and control operations in Canada in cooperation with the Canadian Government or local Canadian authorities, and the employment of Canadian citizens, \$2,700,000.

The words "incipient and" have been omitted from the appropriation title which now refers simply to "emergency" outbreaks of insects and plant diseases. This term is considered sufficiently broad to use in the general title since the language of the item refers to the joint resolution approved May 9, 1938 (7 U. S. C. 148-148e), which specifically authorizes work against incipient as well as emergency outbreaks. The word "pests" has also been omitted since obviously control would not be attempted against beneficial or harmless insects.

The proposed language includes authority for the purchase of aircraft for which specific authority is required under proposed provisions of Section 203 of the Independent Offices Appropriation Bill as recommended in the Budget. Airplanes are necessary for applying suppressive measures against Mormon crickets, grasshoppers and white-fringed beetles. Much of the control work on Mormon crickets involves applying bait to areas that cannot be reached with ground equipment. Some of the planes used on this work are approaching the end of their serviceable life and replacements will be needed during the fiscal year 1946.

WORK UNDER THIS APPROPRIATION

This appropriation was included for the first time on a regular fiscal year basis in the annual Appropriation Act for the fiscal year 1945 and its continuance on that basis is proposed for 1946. For practical operating purposes, however, work done under this appropriation is conducted on a crop season basis, and the following paragraphs will summarize briefly the activities for the past season, including certain information with reference to work underway at the present time.

Following is a list of the appropriations which have been made for Emergency Outbreaks of Insects and Plant Diseases since the program was first authorized by Public Resolution No. 20, approved April 6, 1937:

<u>Reference to Act</u>	<u>Amount</u>
Public Resolution No. 26, approved April 27, 1937 ..	\$1,000,000
Public Resolution No. 55, approved July 17, 1937 ...	1,000,000
Public Resolution No. 81, approved March 2, 1938 ...	2,000,000
Second Deficiency Appropriation Act, 1938	700,000
First Deficiency Appropriation Act, 1939	3,000,000
Public Resolution No. 22, approved June 13, 1939 ...	1,750,000
First Deficiency Appropriation Act, 1940	2,500,000
Second Deficiency Appropriation Act, 1940	800,000
First Deficiency Appropriation Act, 1941	2,225,000
Sixth Supplemental National Defense Appropriation Act, 1942	1,750,000
First Deficiency Appropriation Act, 1943	3,722,000
Department of Agriculture Appropriation Act, 1945 ..	2,700,000 *

*Available to June 30, 1945; however, it may be necessary to request a supplemental appropriation to provide for an anticipated increase in operations from the beginning of the 1945 field season until July 1, 1945.

A substantial part of the funds provided by these several appropriations in the past have been used to enable the Department to cooperate with States in combating widespread outbreaks of grasshoppers, and to take active large-scale control measures against the Chinch bug, the white-fringed beetle, the Mormon cricket, and the pear psylla. Work has been done from year to year against other pests which, although less widespread, are nevertheless serious threats to important agricultural commodities.

Operations against the white-fringed beetle, the pear psylla, and the Hall scale have built up a sufficient background of information to permit advance determination of the nature and probable extent of the program that should be carried out during a fiscal year to combat these pests. The foregoing project statement indicates the actual obligations for the fiscal year 1944 and the estimated obligations for fiscal year 1945.

White-fringed beetle: In cooperation with the affected States the white-fringed beetle control program provides for (1) suppressing populations in areas from which there is a hazard of spread by application of insecticides or herbicides in the vicinity of railroad yards, shipping centers, processing plants, warehouses, etc., and on preferred host crops, the handling and marketing of which present a danger in the dissemination of this pest; (2) eliminating by intensive insecticidal treatment, outlying incipient infestations; (3) treating, or otherwise processing farm produce or other articles which are moved from infested to non-infested areas and which are liable to transmit the insect; (4) making intensive inspections of areas in the immediate vicinity of known infestations and surveys in areas farther removed, particularly in the vicinity of transportation

centers and along railroads and highways to find any new or previously undiscovered infestations before they have had an opportunity to develop to damaging proportions; (5) promoting cultural and cropping practices in infested areas, alternating procedures and crops in such a way as to provide unfavorable host plants and farm conditions as frequently and for such periods as reasonably profitable culture will permit; (6) assisting farmers in suppressing beetle populations by ~~furnishing insecticides~~ and equipment for their application to prevent further dissemination with the understanding that control measures by them will be applied under the supervision of the cooperative field project personnel; and (7) supplementing the foregoing plans for prevention of spread with the inspection in transit of shipments liable to carry the pest, returning such shipments as are manifestly dangerous and which cannot be treated so as to eliminate hazard of spread of the insect.

The pear psylla, an insect of European origin, has been established in the northeastern United States for more than 100 years but was not found west of the Mississippi River until July 1939 when it was discovered in Spokane County, Washington and in adjacent areas in Idaho. Its general establishment in the commercial pear orchards of the West, which produce more than 70 percent of the pears of the United States, would result in a marked increase in the cost of producing pears in addition to the losses that growers would experience in form of reduced yields and poor quality fruit. The program includes three steps (1) survey and inspection to delimit infestations, (2) spraying to suppress or eliminate known infestations, and (3) removal of abandoned pear trees, stumps and regrowths which serve as sources of reinfestation of commercial orchards.

Hall scale: The Department is cooperating with the State of California in an effort to eradicate an incipient outbreak of Hall scale near Chico, California. This insect is a serious pest of almond, peach and plum, and is known to attack a wide range of host plants some of which are native to the western part of this country.

Operating programs against other insects which are the subject of control under this appropriation cannot be planned in advance with equal facility as it has not been possible to determine to the same extent the location and extent of anticipated outbreaks. Work against grasshoppers, however, has been conducted for a number of years in cooperation with practically all the States west of the Mississippi River. During the 1944 season grasshoppers were generally more abundant than in 1943 from Texas north to Montana and North Dakota. While the infestation was spotted, destructive populations developed locally in a group of counties in southcentral Texas, in certain counties in Kansas, Nebraska, Colorado, Wyoming, Montana, and North Dakota, with a particularly damaging outbreak in central South Dakota where the most extensive program of the year was conducted.

The 1944 program for the area as a whole may be briefly summarized as follows: 266 counties in 23 States organized for control work and entered into formal agreements with the States and Bureau as a prerequisite to receiving bait materials. Fifty-five counties in five States (Kansas, Nebraska, North Dakota, South Dakota, and Montana) where the fall egg survey indicated destructive populations for 1944 undertook a more

intensive type of program. In these counties all roadsides, railroad right-of-ways, idle lands, and public lands adjacent to crop areas were baited with Federally-owned power equipment at the same time that farmers were applying bait to protect their own crops. Some counties reported 80 to 85 percent farmer participation. In these counties the grasshopper population has been building up for the past two to four years and the object of the coordinated program was to reverse this trend if possible, in addition to protecting this year's crops.

In 1944 Mormon cricket infestations developed very much as indicated by the egg surveys in the fall of 1943. Control work was necessary in 15 counties in six States (California, Colorado, Idaho, Nevada, Oregon, and Wyoming). The more extensive outbreaks occurred in Nevada and Idaho. Control operations were initiated in June and continued with only brief interruptions due to adverse weather until the early part of August. Crop damage from Mormon crickets this year will be limited to isolated spots and preliminary observations as to the effectiveness of cooperative baiting in these areas indicate that the results of this year's program should be reflected in reduced populations next year.

In 1944 a moderate to severe outbreak of chinch bugs developed in 83 counties in the States of Illinois, Indiana, Kansas, Missouri, Nebraska, and North Carolina. Barrier materials were made available to farmers to combat these outbreaks. There are some present indications that an unusually severe outbreak of chinch bugs is to be expected in the spring of 1945.

Operations were conducted during 1944 against the mole cricket of which a native species as well as an introduced species from Puerto Rico are particularly destructive in the fall and winter truck crop sections of Florida.

Funds provided under this appropriation have also been used to carry on surveys to secure information on the abundance and the threat to crop production of certain important crop pests including insects attacking cotton, the Mexican bean beetle, pea aphid, cabbage worms and other pests of truck crops, the screwworm, and other insects requiring the use of insecticides. The information secured from these surveys has been made available to farmers and to agencies concerned with the production and distribution of insecticides as well as to cooperating State officials. The information secured has served as a guide to industry in the prompt and effective distribution of insecticides, many of which are severely limited by the fact that they are produced from materials under allocation because of war needs. This information has also served to enable farmers to plan in advance their operations against crop and livestock pests.

Surveys have also been carried on to secure information on pests of limited distribution and those subject to State quarantines. These surveys dealt principally with three important pests--the Oriental fruit moth, the potato tuber worm and the golden nematode.

PASSENGER-CARRYING VEHICLES

Salaries and Expenses: Of the 13 new cars requested, six are for use in connection with the research work of the Bureau. Two will be used by the Japanese beetle laboratory, Moorestown, N. J., in connection with the distribution of the milky disease of the Japanese beetle. This program involves travel to widely separated points not accessible by common carrier. One car will be headquartered at Berkeley, Calif., on the Forest Insect project and used for making surveys of insect conditions and inspecting work in forest areas. One car is for use at Orlando, Florida, in making necessary trips to experimental areas and in connection with the demonstrations to the military of the proper uses of fumigants, repellents, and larvicides for the extermination or repellence of mosquitoes and other insect pests. In the case of the other two cars, these would normally be traded in, but in view of the age and mileage of many of the old cars to be retained it is believed desirable to retain two cars which would otherwise be traded for use in case of breakdowns or other emergencies.

A substantial increase in the funds for the item Foreign Plant Quarantines necessitates the purchase of seven additional cars to provide for the intensive supervision of the personnel and work because of the problems arising from greatly expanded commerce. These cars will be used by inspectors visiting ports of entry: They will be headquartered at St. Paul, Minn.; Galveston, Houston, and Port Arthur, Texas; Charleston, S. C.; New York, N. Y.; and Seattle, Wash.

Control of Emergency Outbreaks of Insects and Plant Diseases: Heretofore, no passenger-carrying cars have been purchased for projects under this appropriation, but the need for them has become very pressing, and provision for 28 has been made in the Budget schedules.

The grasshopper and Mormon cricket area is very extensive, covering 26 Western and Mid-western States, and passenger-carrying cars are badly needed for use by field supervisors in making surveys to determine abundance of grasshoppers and Mormon crickets, and in control operations. Twenty such cars will be of great value in the effective prosecution of this work.

Four passenger cars are greatly needed by supervisors for control operations throughout the White-fringed Beetle Control area, comprising the States of Louisiana, Mississippi, Alabama, Florida, and North Carolina.

The work in the Pear Psylla Control area of Washington, Oregon, and Idaho requires four passenger-carrying cars for the use of supervisors.

PENALTY MAIL
Section 2, Public Law 364, 78th Congress
(Allotment to Bureau of Entomology and
Plant Quarantine)

	<u>Category 1</u>	<u>Category 2</u>	<u>Total</u>
1945	\$2,200	\$11,030	\$13,230
1946	2,700	13,300	16,000
Change	+500	+2,270	+2,770

Category 1 consists of leaflets, bulletins and other technical publications issued as a result of research work on entomology and mailed in answer to specific requests for information and for partial reply to inquiries regarding the programs of the Bureau.

Category 2 consists of general administrative correspondence between the field stations of the Bureau and Washington, and with State Departments of Agriculture, State colleges, and experiment stations cooperating with the bureau in its programs. There is also included correspondence in connection with requests for information on the identification of insects and for advice on control programs such as Japanese beetle control, pink bollworm and Thurberia weevil, sweet-potato weevil, white pine blister rust control and many others.

The increase of \$2,770 for 1946 will be needed to defray additional cost of operational mailings and dissemination of information on the work of the Bureau as a result of Budget increases for (1) research on DDT (\$50,000), (2) foreign plant quarantine (\$206,893), and (3) white pine blister rust control (\$1,319,200).

BUREAU OF AGRICULTURAL AND INDUSTRIAL CHEMISTRY

(a) Salaries and Expenses - Preamble

CHANGE IN LANGUAGE

The estimates include proposed change in the language of the appropriation preamble as follows (new language underscored, deleted matter enclosed with brackets):

For investigations, experiments, and demonstrations herein-after authorized, independently or in cooperation with other branches of the Department, other departments or agencies of the Federal Government, States, State agricultural experiment stations, universities, and other State agencies and institutions, counties, municipalities, business, farm, or other organizations and corporations, individuals, associations, and scientific societies, including the employment of necessary persons and means in the city of Washington and elsewhere, of which not to exceed [\$198,280] \$176,528 may be expended for personal services in the District of Columbia [; and for erection, alteration, and repair of buildings outside the District of Columbia: Provided, That the cost of erecting any one building shall not exceed \$7,500, and the cost of alterations to any one building shall not exceed \$500 or 2 per centum of the cost of the building as certified by the Secretary, whichever is greater], as follows:

The proposed change in language deletes the provision relating to erection, alteration, and repair of buildings outside of the District of Columbia, as a general limitation on expenditures for these purposes, for all bureaus of the Agricultural Research Administration, is proposed in the Budget language for the Office of Administrator.

(b) General Administrative Expenses

Appropriation Act, 1945	\$82,250
Proposed consolidation in 1946 estimate with	
"Agricultural chemical investigations"	-61,690
"Naval stores investigations"	<u>-20,560</u>
Total available, 1945	-

The 1946 estimates propose that this subitem be transferred to and consolidated with other subitems under this Bureau, as indicated above. Similar recommendations are made in the estimates for all bureaus of the Agricultural Research Administration, where such consolidations have not previously been effected.

(c) Agricultural Chemical Investigations

Appropriation Act, 1945	\$313,411
Proposed consolidation in 1946 estimates from "Salaries and expenses, Agricultural and Industrial Chemistry, Agricultural Research Administration," general administrative expenses	+61,690
Total available, 1945	375,101
Budget estimate, 1946	335,000
Change for 1946:	
Overtime decrease	-48,930
Increase	+8,829
	<u>-40,101</u>

PROJECT STATEMENT

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
1. Fruits, vegetables, and other agricultural products of the South	\$45,797	\$75,562	\$77,562	+2,000 (1)
2. Sugars and sirups investigations	62,771	75,469	75,469	- -
3. Investigations on pharmacology of agricultural products	22,915	28,193	29,463	+1,270 (1)
4. Investigations on enzymes and phytochemistry	19,583	30,434	31,434	+1,000 (1)
5. Fruits, vegetables, and other agricultural products of the West	37,422	43,941	45,500	+1,559 (1)
6. Fundamental investigations in microbiology of agricultural products	24,694	36,394	36,894	+500 (1)
7. Tung nuts investigations	24,110	27,807	27,807	- -
8. Basic investigations in the chemistry of agricultural products	695	8,371	10,871	+2,500 (1)
9. Overtime costs	36,175	48,930	- -	-48,930
Unobligated balance	59,053	- -	- -	- -
Total available	333,215	375,101	335,000	-40,101
Transferred to "Salaries and expenses, Office of Information"	+102	- -	- -	
Total estimate or appropriation (1944 and 1945 adjusted for comparability)	333,317	375,101	335,000	

INCREASES OR DECREASES

The net decrease of \$40,101 for 1946 consists of the \$48,930 decrease for overtime, and the following:

(1) An increase of \$8,829 to provide additional funds for operating expenses in connection with projects under this subappropriation, as follows:

(a) \$2,000 for citrus utilization research work. Much research remains to be done in order to raise citrus processed products to a point where they may be assured of competitive outlets for peacetime markets if the increased volume in citrus fruit production is to be maintained anywhere near the current level.

(b) \$1,270 for furthering the investigations on the pharmacology of agricultural products to determine the toxicity of food, feed or medicinal products resulting from new processing procedures developed by this Bureau.

(c) \$1,000 for the investigations of enzymes and phytochemistry will aid in the research being directed toward a better understanding of the chemical changes caused by the reaction of enzymes in agricultural products, with a view to increase of storage life, improvement in product quality, and simplification of manufacture.

(d) \$1,559 for the further development of dehydration freezing and otherwise preserving of fruits and vegetables grown in the Pacific area as a means of more complete utilization of the crops under peacetime conditions.

(e) \$500 to assist in the solution of various microbiological problems relating to the keeping quality of dried eggs and other agricultural products, and

(f) \$2,500 for basic investigations on the chemical nature of a wide variety of biologically active chemical compounds found in growing green plants, in order to open up a new approach to the important problem of the prevention and control of plant diseases.

WORK UNDER THIS APPROPRIATION

Objective: To increase farm income by solving problems which cause loss of value of crops or which interfere with their consumption along established lines; to devise means of reducing deterioration and prevent spoilage of agricultural commodities between harvesting and processing, during storage, and after processing; to reduce handling and processing costs; to determine the relative suitability of various processing treatments in relation to crops grown under various agricultural conditions; to render technical assistance to farmers' cooperative processor organizations; to assist in developing "deficiency" crops, (e.g. tung nuts) the output of which in this country does not nearly supply domestic requirements and for which there is urgent need to improve the efficiency

of handling, preparing, and processing the crop; and to develop needed feed supplies from farm byproduct materials not heretofore fully utilized.

The Problem and its Significance: Lend-Lease and our armed forces have absorbed the greatly increased production of food during the war, and our contribution has been to develop better methods of processing and handling of a wide range of food products, and to create replacements for and supplements to formerly imported products from agricultural materials. Furthermore, when there is a decrease in demand for war needs, and an increased availability of foreign produced commodities, basic and applied research data will be urgently needed for the peacetime utilization of products of such industries as the citrus industry, which is now processing a substantial portion of the citrus crops for juices, concentrates, marmalades, and similar materials for Lend-Lease military service requirements. A similar type of research will be needed to take care of the problems arising for fruits other than citrus, vegetables, tung nuts, etc.

General Plan: In general, basic work is conducted under this appropriation and applications made, at 12 field stations located in areas where production of the crops involved is greatest. The entire appropriation is being applied to work of the character indicated. Cooperation is maintained with the Army, Navy, and other bureaus of the Department, and State agricultural experiment stations.

Examples of Progress and Current Programs: The following statements of current programs and examples of recent accomplishments under this appropriation are cited by financial projects:

Fruits, Vegetables and Other Agricultural Products of the South: Development of the method for preserving vegetables by salting or brining has opened up a new branch of the food industry. Originally devised as a means for alleviating the shortage of tin cans and glass containers to prevent loss of season-end vegetables in produce areas where canning facilities did not exist the method became very popular with Victory Gardeners and large commercial food manufacturers. Such vegetables as peas, lima beans, okra, corn, string beans, carrots, kale, and certain other leafy vegetables are preserved in salt brine (with or without acidic fermentation as desired) in barrels, casks, crocks, glass or other containers not requiring metal or rubber, or the use of processing machinery and equipment. Information regarding the method was made available by distribution of nearly 400,000 copies of Farmer's Bulletin No. 1932, "Preservation of Vegetables by Salting or Brining." A survey of householders and commercial concerns following the 1943 vegetable harvesting season revealed that many millions of pounds of food were preserved by each group using this method. About 20 million pounds were preserved in barrels in the Pacific Northwest alone for commercial soup manufacture. Commercial food manufacturers indicate their intention of continuing use of this method following the present emergency as a means of saving labor, containers, and processing equipment in vegetable producing areas where canning facilities do not exist. This method of preserving food is being used in reoccupied areas where other means of preservation are inadequate. Continued research is contemplated in order to perfect the method to insure maximum retention of nutritive values.

Notable progress was made in the development of citrus products for food, feed, and other purposes. More than two million gallons of concentrated orange juice were made in Florida for shipment overseas to United States armed forces and our allies. Technical assistance was given to processors and research was conducted to solve problems related to keeping quality and retention of maximum nutritive value. Two methods were developed for the storage of pectin-containing materials and recovery of pectin from citrus canning plant pomace without the use of special equipment. An application has been made for a public service patent covering use of one of the methods. As a result of demonstrating the feasibility of utilizing citrus by-products for the manufacture of alcohol, a plant has been constructed in Florida and will use citrus molasses as its source of fermentable sugar. A feed-yeast manufacturing plant is being constructed, and will also use citrus molasses as its source of sugar. The yeast produced will help to relieve the shortage of protein feed. Citrus molasses results from concentrating press liquor obtained during the manufacture of cow feed from citrus peel. Conversion of citrus by-products into valuable industrial products and livestock feed contributes to the solution of the problem of waste disposal and provides greater

financial return to the industry. The production of dehydrated orange juice is being investigated as a possible means of effecting conservation of packaging materials, shipping space and weight, and better retention of flavor and nutrients as compared to canned straight or concentrated juice. The Florida and Texas citrus industries are undergoing rapid expansion and in order to provide outlets for the entire production each year at a profitable return to growers and processors, new products and uses for byproducts will need to be developed through a program of intensive research.

Further experimental evidence was obtained that silage made from sweetpotato vines can help to overcome the shortage of winter stock feed in the South. Feeding tests made by the North Carolina Agricultural Experiment Station in cooperation with the Bureau of Agricultural and Industrial Chemistry showed that sweetpotato-vine silage was equal to good green-corn silage when fed to milk cows. To meet the need for an inexpensive method of storing sweetpotato silage on small farms, where the usual type of upright silo can not be built because of high cost, the practicability of the trench silo and possibly other storage devices will be investigated. Experiments will be made on the preparation and relative feeding values of silage from various combinations of vines, cull sweetpotatoes, molasses, and other modifiers.

Because of the desirability of obtaining representative geographical distribution of facilities for dehydrating vegetables for overseas shipment and use in the United States, and because of doubts which have been expressed regarding the suitability for dehydration of rapidly grown southern vegetables, dehydration tests representing typical varieties of vegetables and environmental factors were conducted in important producing areas of the South. Conditions determining suitability and unsuitability for dehydration of various southern vegetable varieties and producing areas were determined. Technical assistance was given to a number of operators of dehydrating plants.

Sugars and Sirups Investigations: Further progress has been made in the development of a process for the recovery and refinement of sugarcane wax as a byproduct of the cane sugar industry by the perfection of a method for separating colored materials and other impurities from the wax. A large quantity of sugar factory press cake was processed for wax in a lignite plant at Malvern, Arkansas, with encouraging results. It is expected that commercial processing will begin soon for the recovery of wax to be employed as a substitute for imported waxes (e. g., Montan, Carnauba, Candelilla and Japan waxes) which are either unavailable or are in short supply. These waxes are important for various critical uses, such as, waterproofing of various types of military equipment; waterproofing and treatment of leather, weatherproofing and lubrication of marine cordage, as expanders and blending agents in molding rubber articles, carbon paper, etc.

A process for demineralizing sorgho and other sugar juices prior to the production of sugar was discovered and application was made for public service patent covering use of the process. One of the naturally occurring acids in sugar-bearing plants is aconitic acid and especial attention was

given to its recovery and the development of its derivatives, some of which are now in use in plastics and rubber products to prevent brittleness and cracking at low temperatures. They are especially useful in rubberized or plastic parts used on airplanes. Aconitic acid is an important by-product of sorgo sugar and is also obtainable as a by-product of the cane sugar industry. This represents a large natural source of supply, is present in greater quality and available at lower cost than the present synthetic source. It is expected that progress will be made in the development of these new natural sources of supply, acid recovery and preparation of special compounds in the future.

Considerable progress was made in developing a low-cost farm-scale method for dehydration of sweetpotatoes for cattle feed, using both culls and sweetpotatoes grown specifically for the purpose. An inexpensive disintegrating machine and rotary drier was developed. Application was made for a public service patent for a combination hot bed and dehydration unit.

Investigations on Pharmacology of Agricultural Products: The primary function of the Bureau's Pharmacological Laboratory is to determine the possible toxicity of products developed in the Bureau that have prospects of food, pharmaceutical or medicinal use, and also of contaminants that might be encountered in food products as a result of new processing procedures. It is not safe to proceed without tests of this sort. Some new products have, of course, been found acceptable so far as toxicity is concerned and later have achieved widespread application. An example is phenothiazine, which is used to kill certain internal parasites of livestock. The lack of toxicity of this drug was first determined by the Pharmacological Laboratory.

Among the materials now being investigated with regard to their toxicity are: (1) Lysozyme, a bactericide which may be recovered from egg white; (2) Citrinin, a product produced by molds; and (3) other antibiotics. During the past year a number of bioassays of vitamin A in fresh and dehydrated vegetables were made in connection with vegetable dehydration studies at the Western Regional Research Laboratory. Additional tests and determinations will be made as new products are developed which require this type of testing.

Investigations on Enzymes and Phytochemistry: A major objective in research on enzymes is to use the enzymes, as they exist in agricultural commodities, for useful purposes such as improvement in product quality, increase in storage life, and simplification of manufacture. The so-called sulphite process for industrial manufacture of alcohol from wheat, on which work was completed and reported last year, makes use of the diastase in wheat and thus saves malt, an enzyme preparation added in the usual process. Two manufacturers using the sulphite method have reported a monthly production that totals over a million gallons of alcohol, at which rate there would be an indicated saving of more than 20,000 bushels of malt per month.

Recent research has revealed a method by which uncooked starch can be saccharified rapidly. This discovery has great potential value for both in-

dustry and investigative science. The method not only converts uncooked starch to sugar rapidly, but converts 100 percent of the starch used. It has been known, of course, that conversion of uncooked starch takes place but no method of rapid conversion outside the animal body has been discovered. Development of practical application will require time and possibly work in many laboratories. Continued work on the breakdown of starch by enzymes is likely to bring important results.

Newly organized phytochemical work is being directed toward an understanding of the chemical changes caused by enzymes during the ripening of grain. Artificial means (some already known) of speeding up the ripening will be studied; the object will be the lengthening of the life of grain in storage by making sure that it is ripe beforehand.

Fruits, Vegetables and Other Agricultural Products of the West: Treatment of cabbage with sulfite has become standard practice in the dehydration industry and is required if the product is to be sold to a Government purchasing agency. The introduction of this step has required the solution of several problems. An important one was the determination of the optimum amount to use. Tests for this purpose were conducted in the Los Angeles laboratory and reported directly to dehydrators. In addition, tests were conducted and reported on methods of applying the sulfite solution to cabbage. This information has had wide application inasmuch as several million pounds of sulfited, dehydrated cabbage have been produced for wartime use since the introduction of the method.

Domestic production of dates, 95% of which is in California, was approximately 11,000 tons in 1943, with a farm value of \$4,000,000. Difficulty is encountered in the preparation of ripe dates for market because dust and dirt adhere to the sweet ripe fruit during harvest. The present method for removing this dirt requires rolling of dates over Turkish toweling, and at best does not result in a thorough job; furthermore, the method requires frequent changes and laundering of towels. Tumbling or rolling the dates through a spray wash, followed by drying in circulating warm air has been tried on a laboratory scale with preliminary success and is being considered experimentally as a new process. Further work is needed, and it will also be necessary to study the keeping quality, particularly the control of mold, on dates thus treated.

In the Pacific Northwest canners of peas are troubled by nightshade berries and other weed seeds that are inseparable by usual mechanical cleaning methods. A tolerance under Federal food standards has been established for these contaminating materials, and packers whose products do not come within the tolerance are penalized. Several canning companies have estimated that rejections of shelled peas due to nightshade amounted to from 3 to 10 percent of their production in 1941. This is in addition to the losses sustained by pea growers by an additional 7% left in the field unharvested. Removal of these materials requires hand labor. At the Pullman station a continuous mechanical process has been developed which removes such foreign material by a simple flotation process. Nightshade and similarly shaped foreign seeds are caused to float while the peas sink, thus making separation possible. Three commercial pea canners have applied for and have been

granted permission to use the process, which is available under a public service patent.

During the past 10 years the canning of soft-ripe freestone peaches has become an important industry in the Pacific Northwest, reaching 750,000 cases in volume in recent years. Four journal articles, which summarize conclusions reached on canning quality of varieties, time of harvest, and storage and ripening procedures prior to canning, were published in the spring and summer of 1944. Other reports were made earlier in the course of the investigations. Several commercial canning companies and the Washington Agricultural Experiment Station have cooperated in these investigations.

Fundamental Investigations in the Microbiology of Agricultural Products:
Eggs and Egg Products: In 1944, 78.4 million pounds of dried whole egg were allocated to military and war services, 216.7 million pounds to Lend-Lease, and 2.2 million pounds to other exports and shipments. Numerous microbiological problems relating to the keeping quality and healthfulness of the finished product have arisen largely because of the newness of the industry and because of the hurried and ingenious ways devised by the industry to meet needs for mass production for refrigeration and other processing equipment, for trained personnel and for improved processing methods. Some lots of powder have undergone spoilage and other lots have been condemned by Lend-Lease purchasers because disease-producing microorganisms were found to be present. Quality standards for the manufacture and sale of dried egg do not exist except as indicated in purchase specifications. There is a definite need to improve the microbial quality of U. S. manufactured whole egg powder and to investigate processing, handling and storage methods, in order that spoilage may be prevented and any risks to the consumer's health eliminated. An allotment of Lend-Lease funds has been made to cover certain aspects of the work on dried eggs.

Studies regarding the incidence of certain types of microorganisms are being made throughout the spring, summer, fall and winter months for the purpose of gathering data of seasonal, geographical and operational significance. Emphasis is also being placed on investigations pertaining to: (1) improvement of existing methods for examining eggs microbiologically; (2) shell egg washing and disinfection prior to drying; (3) storage time and temperature influence on microbial flora in dried eggs; (4) improvement of plant sanitation; and (5) quality of the raw material being used.

From data obtained to date from the above studies, it would appear that during the hot summer months microbial contamination in egg products is greater in spite of special hot weather precautions taken in handling the raw material. Data have been collected to permit setting reasonable tolerances for commercially produced whole egg of the agar plate (viable) count and the direct microscopic count of microorganisms. Soiled shell eggs were demonstrated to be responsible for the entrance of many undesirable spoilage and pathogenic bacteria into liquid egg and hence into the powder. High storage temperatures (21° to 46° C.) were found to be detrimental to contaminating bacteria in egg powder but unfortunately also destructive of desirable physical properties. The presence of thermophiles or molds in new powder usually signifies faulty processing and the presence of either may be used as an indicator in plant control studies.

Detailed research data is being made available to war agencies as rapidly as obtained and is being used in the preparation of purchase specifications and in evaluating the quality of powder offered for Lend-Lease purchase. The industry is making immediate use of the information supplied as follows: (1) to locate and correct operating ills responsible for high microbial counts in liquid and powdered eggs; (2) to demand higher quality shell eggs for dehydration and to insist on more careful handling of the same; (3) to exercise greater sanitary control over general plant operations; (4) to establish priority justification for stainless steel and refrigeration equipment essential to the manufacture of a high quality powder; (5) to serve as a basis for and guide to continued endeavor to improve powder quality; and (6) to serve as an inspiration to the competitive production of quality powder. These last two uses to which industry is putting the government's findings attain special significance when consideration is given to the facts that drying temperatures directly influence the microbial quality, palatability and solubility of a given powder and that the microbial quality tends to vary with the palatability and solubility. Therefore, to produce a low microbial count, high palatability, high solubility powder which on reconstitution will more nearly approach the fresh egg, industry must dry high quality shell eggs and follow sanitary principles in all stages of processing, handling, storing, transportation and distribution.

Tung Nut Investigations: A very definite shortage of drying oils and particularly of tung oil now exists in the United States. Drying oils are urgently needed for the production of paints, varnishes, etc., for protecting surfaces of military equipment and structures, and for certain essential war uses. For this purpose tung oil is the outstanding drying oil and is indispensable for some equipment. In view of the present serious shortage of drying oils, efforts have been continued to assist the domestic tung industry to establish itself on a sound technological basis. Investigations have indicated the possibility of hulling the moist tung fruit on the farm by use of a new tung fruit huller, provided adequate means are provided for dehydrating the moist dehulled tung fruit to prevent the deterioration of the oil present in the tung kernels. Investigations have indicated that it is possible to extract practically 100 percent of the oil from dehulled tung fruit by the use of n-hexane in a continuous counter-current extraction process, if the dehulled tung fruit have been brought to a proper moisture content before they are prepared for extraction with rolls.

It is expected that definite results will be obtained from studies relating to the storage and dehydration of tung fruit in preparation for extraction of the oil. In the case of material hulled on the farm preliminary to milling it will be necessary to observe carefully the effect of storage on quality of oil, particularly since American manufacturers require high quality oil with a low acid content. Storage, dehydration and hulling processes will be carefully integrated with the extraction process to insure a high quality product.

Introduction of a commercial solvent extraction process is anticipated during the coming year.

Basic Investigations in the Chemistry of Agricultural Products: Although it is well known that the growing green plant elaborates a wide variety of

biologically active chemical compounds, little precise knowledge exists of the chemical nature of most of these substances or the role which they play in the economy of the plant. There is evidence of the existence of certain plant constituents the chemistry of which is unknown, which play significant parts in the growth and survival of the plant. It is entirely possible and likely that growing green plants elaborate chemical compounds with specific antibiotic activity against invading organisms which cause plant diseases. Plant breeders have succeeded in developing strains and varieties of plants which show remarkable resistance to diseases, yet very little is known about the development of such immunity, what it is that establishes it, or how it can be enhanced. With the scientific background and knowledge that has now been developed in the production of antibiotics by fungi and the established fact that disease-resistant strains of plants can be produced, it is now believed to be possible through chemical research to open an entirely new approach to the important problem of the prevention and control of plant diseases.

In order to do so it is planned in cooperation with plant breeders, physiologists, and pathologists to select the plant varieties to be studied, to test extractions from various plant tissues for the presence of specific agents, to identify such agents, and to investigate their chemical and antibiotic properties.

(d) Naval Stores Investigations

Appropriation Act, 1945	\$112,100
Proposed consolidation in 1946 estimates from "Salaries and expenses, Agricultural and Industrial Chemistry, Agricultural Research Administration" general administrative expenses	+ 20,560
Total available, 1945	<u>132,660</u>
Budget estimate, 1946	<u>125,000</u>
Change for 1946:	
Overtime decrease	- 15,865
Increase	+ <u>8,205</u>
	<u>- 7,660</u>

PROJECT STATEMENT

Project	1944	1945 :(estimated):	1946 :(estimated):	Incr. or decr.
1. Naval stores investigations:				
(a) Investigation of naval stores production, processes and equipment	\$ 37,322	\$40,747	\$ 44,619	:+3,872(1)
(b) Investigation of composition, properties, components, and derivatives of naval stores	18,959	35,584	38,251	:+2,667(1)
(c) Investigation of uses, handling, and transportation of naval stores	20,829	40,464	42,130	:+1,666(1)
(d) Improvement and repairs at the naval stores station, Olustee, Florida	3,000	- -	- -	- -
2. Overtime costs	11,583	15,865	- -	:-15,865
Unobligated balance	41,737	- -	- -	- -
Total estimate or appropriation(1944 and 1945 adjusted for comparability)	133,430	132,660	125,000	:-7,660

INCREASES OR DECREASES

The net decrease of \$7,660 for 1946 consists of the \$15,865 decrease for overtime, and the following:

(1)

(1) An increase of \$8,205 to intensify essential research on the following projects:

(a) \$3,872 to further studies relating to the testing of new methods and techniques and designing of new equipment for the production and processing of naval stores.

(b) \$2,667 to further research on composition, properties, components and derivatives of rosin, resin, turpentine, etc., with a view to improving the products as well as improving the consistency of results obtained, and

(c) \$1,666 to further investigations on the uses, handling and transportation of naval stores, from which valuable data is made available on such matters as the consumption and stocks on hand, by grades and users, of various naval stores products.

WORK UNDER THIS APPROPRIATION

Objective: To develop improved methods and equipment for the production of turpentine and rosin in order to make available products more nearly meeting the physical and chemical requirements of the consuming industries; to determine the chemical composition of pine oleoresin (pine tree gum) and the various turpentines and rosins in order to produce derivatives which may prove of industrial value; and to develop methods of handling, packaging, and storing naval stores which will minimize deterioration.

The Problem and its Significance: The continued wide use of naval stores and derivatives to meet specific requirements with increasing demand both at home and abroad makes it essential that further improvements be made in methods of production using less labor, and less critical materials. The needs of our Allies for naval stores normally supplied by France, Spain, Portugal, Greece and India must be met largely from production in this country.

Inadequate supplies of many products in the field of protective coatings, soapmaking materials, resins, plasticizers, rubber intermediates, make it essential that possible suitable derivatives of naval stores be produced and evaluated.

The acute rubber situation has created an increasing need for "intermediates" for making synthetic rubber and various chemicals and derivatives needed in the compounding of such rubbers.

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Turpentine derivatives have been obtained which can serve in actual rubber synthesis both individually and in compounding products to impart to synthetic rubber specifically desired properties.

Pine oleoresin is the source of raw materials for synthetic rubber, protective coatings, for drying oil promoters, soap, various chemicals, such as camphor, cymene and styrene derivatives, and other chemicals. It is an annually reproducible crop with potentialities for increased production.

General Plan: The research and technical work conducted under this appropriation comprises studies on production, processes, equipment, composition, properties, components and derivatives, and on uses, handling and transportation of naval stores. Results obtained from studies on composition and derivatives constitute a basis for studies on new uses and applications. Wherever possible, results obtained from studies on composition and new uses are translated into larger than laboratory scale work at the Naval Stores Station.

Examples of Progress and Current Program: The work of the Naval Stores Research work of the Bureau has resulted in the issuing of 5 patents and 8 other publications during the past year.

Investigations of Naval Stores Production, Processes and Equipment: Designs for processing equipment, still sheds and settings and improved techniques of operation have been made available to producers. Seven licenses have now been granted for the use of the government patented process of gum refinement (U. S. Patent No. 2,254,285). During each of the past two crop years approximately 40,000,000 pounds of high grade rosin and 1,500,000 gallons of gum turpentine have been produced under license from the Secretary of Agriculture for the use of this patent. In addition, a license has been granted by the Secretary for the use of U. S. Patent No. 2,295,235 covering an improved process for producing rosin. In cooperation with the Forest Service, tests were made on pine gum obtained from chemically stimulated trees and it has been found that rosin and turpentine of good quality can be made from such gum by processes developed by the Bureau. These studies have helped to reassure operators and producers who are using chemical stimulants to help attain production goals for naval stores. Progress has been made in erecting equipment for the study of turpentine as a source of synthetic rubber and in the development of a still for the continuous distillation of pine gum.

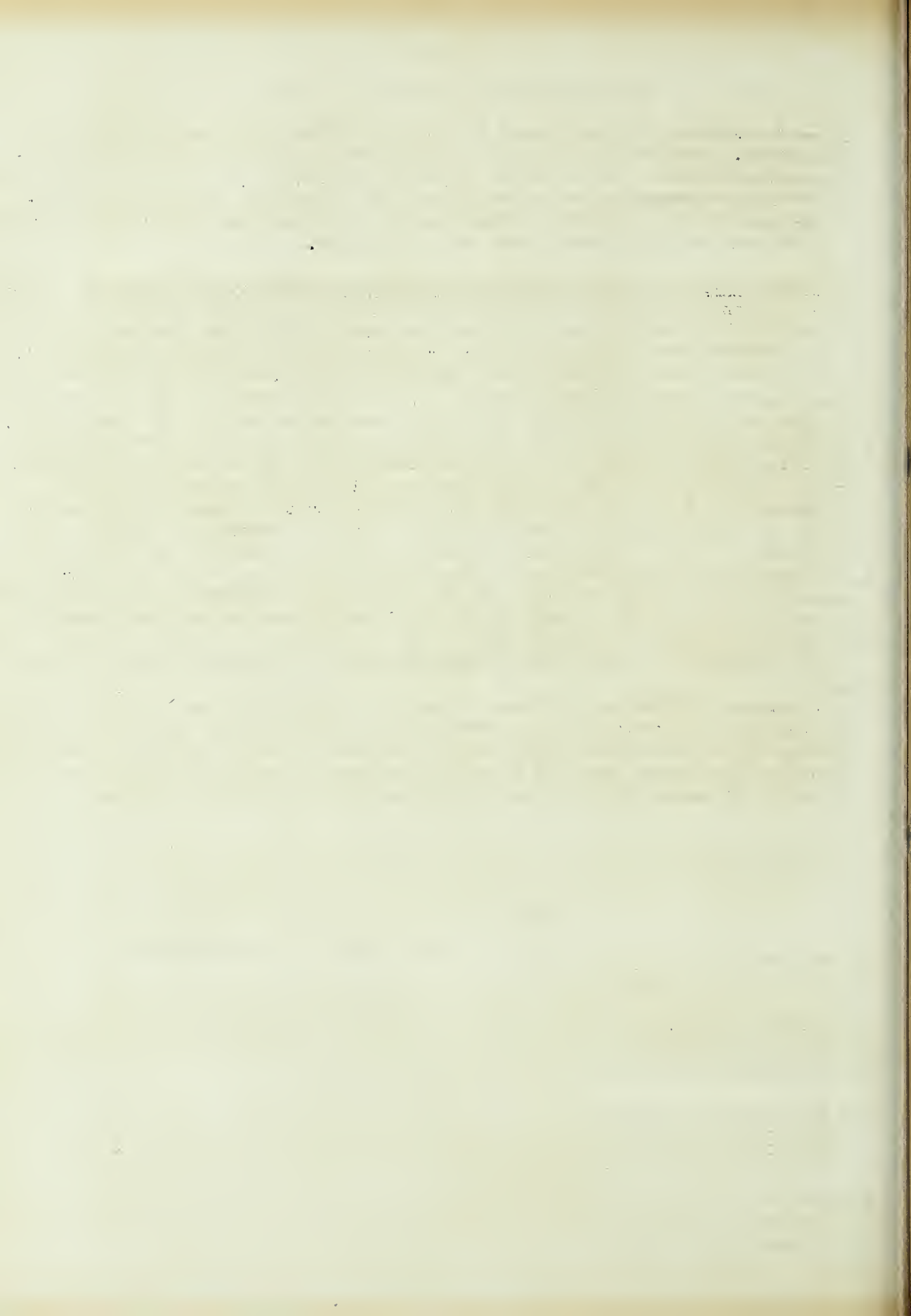
Progress is being made on the development of equipment for the continuous processing of pine gum to replace present batch process; recovery of processing wastes from gum cleaning; protective coatings to extend the life of metal turpentine cups now in use; methods of gum storage to permit year round operation; studies in cooperation with the U. S. Forest Service on the effects of the use of chemical stimulants on equipment currently used by the industry, on techniques of gum cleaning and distillation being developed and on products obtained from the gum; introduction of the information obtained by the Bureau to gum farmers and processors through the Naval Stores Cooperative Agents.

Investigation of the Composition, Properties, Components and Derivatives of Naval Stores: Laboratory methods for the production of two intermediates (myrcene and isoprene) for the production of synthetic rubber from turpentine have been developed. Applications for patents on these processes have been filed and an application for permission to use these processes has already been received. Samples of isoprene and myrcene have been made available to commercial laboratories and tests have shown that excellent synthetic rubber (both solid and latex form) are obtainable from both of these materials. Improved techniques have been developed for carrying out experimental polymerizations and in working up the products thereby improving the products as well as improving the consistency of results obtained. Improved equipment for vacuum fractional distillation has been developed and a patent covering some of this work was granted during the fiscal year 1944.

In the studies on development of synthetic rubber intermediates from turpentine, progress has been made on improving methods of producing and stabilizing myrcene and isoprene; polymerizing myrcene and isoprene, alone or with other monomers, to produce rubberlike materials; examination of rubberlike materials produced from turpentine derivatives; preparation of resins from turpentine components and derivatives.

Investigations of Uses, Handling and Transportation of Naval Stores: Studies on the production of rosin esters from certain alcohols (polyhydric) have established the optimum conditions for carrying out such reactions; a method has been developed for the preparation of the butylene glycol ester of rosin; limed butylene glycol esters of rosin which compare favorably with ester gum have been prepared; a method was developed for the preparation of fused copper resinate; a simple precipitation test for copper in rosin sensitive to less than one part per million has been developed (in some industrial uses of rosin, particularly when it is used in conjunction with rubber, as little as five parts per million of copper may be quite harmful). Data were collected and tabulated on the production, distribution, consumption, and stocks of Naval Stores by quarters; a monthly naval stores survey of stocks and a monthly report on production of Steam Distilled Wood Naval Stores were issued during the year. This statistical data has been made available to war agencies; in addition, a special report was prepared at the request of the War Production Board on the consumption of rosin during the 1943-44 crop year, the stocks as of March 31, 1944, and the anticipated consumption during 1944, all by grades and principal uses.

Progress is being made on esterification of resin acid derivatives, rosin and rosin derivatives; the preparation of rosin and resin acid derivatives for use as compounding ingredients in synthetic rubber and for the emulsion polymerization of monomers to synthetic rubber; compilation of statistical data pertaining to naval stores on a monthly and quarterly basis.



(e) Regional Research Laboratories

Appropriation Act, 1945	\$4,244,600
Budget Estimate, 1946	<u>4,000,000</u>
Change for 1946:	
Overtime decrease	- 497,854
Increase	+ <u>253,254</u>
	- <u>244,600</u>

PROJECT STATEMENT

Project	1944	1945 :(estimated):	1946 :(estimated):	Increase or decrease
1. Southern regional research laboratory	850,047	901,171	969,840	:+ 68,669(1)
2. Western regional research laboratory	825,539	912,587	969,840	:+ 57,253(2)
3. Eastern regional research laboratory	820,926	898,306	969,840	:+ 71,534(3)
4. Northern regional research laboratory	814,337	921,145	969,840	:+ 48,695(4)
5. General administrative expenses	92,244	113,537	120,640	:+ 7,103(5)
6. Overtime costs	453,930	497,854	- -	:-497,854
Unobligated balance	138,667	- -	- -	- -
Total available	3,995,690	4,244,600	4,000,000	:-244,600
Transferred to "Salaries and expenses, Office of Administrator, Agricultural Research Administration"	+ 27,895	- -	- -	- -
"Salaries and expenses, Office of Information"	+ 800	- -	- -	- -
Total estimate or appropriation	4,024,385	4,244,600	4,000,000	

INCREASES OR DECREASES

The net decrease of \$244,600 for 1946 consists of the \$497,854 decrease for overtime, and the following:

An increase of \$253,254 to intensify research work on the development of new uses and markets for agricultural commodities. It is proposed to apply the total increase by commodities as follows:

- (1) An increase of \$68,669 at the Southern Regional Research Laboratory for intensified research on new scientific and technical uses and new and expanded markets and outlets for cotton, sweetpotatoes and peanuts.

Although the general technological improvements which have taken place in the production of many agricultural commodities will have a considerable effect upon their utilization, there are certain developments which are expected to assume special importance to the program of the Southern

Regional Research Laboratory. An example of this is the mechanical harvesting of cotton which it is expected will advance rapidly in the near future. Such mechanical harvesting will unquestionably introduce many new problems in the utilization of cotton which will require attention in the immediate future by the Southern Regional Research Laboratory in order that the best interests of growers and users of cotton will be fully realized. Likewise, increased industrial production of sweetpotato starch will pose many new problems in the production of the starch itself as well as in the more complete utilization of byproducts of sweetpotato processing for starch. With the expansion of peanut acreage, greater efforts will be required to develop processes for the utilization of peanut oil and protein. These problems are of importance and significance from the standpoint of a more effective utilization of agricultural materials as well as for supplying urgently needed finished products of various types.

(2) An increase of \$57,253 at the Western Regional Research Laboratory for expanded research on new scientific and technical uses and new and expanded markets and outlets for apples, alfalfa, fruit, potatoes, poultry, vegetables, wheat and hemlock bark as an emergency source of tanning materials.

During the first years of operation of the Western Regional Research Laboratory emphasis was laid on the development of research projects on a laboratory scale with more limited attention naturally being given to pilot plant operations. With the development of the laboratory research program, an increasing number of additional research projects have now reached a stage where pilot plant scale evaluation of their possibilities is indicated. Specific laboratory projects such as production of low-methoxyl pectins for food purposes, the production of frozen fruit purees of special types, the production of highly liquid-absorbable materials such as gluten sulphate from wheat protein, production of food and feed yeast from fruit and vegetable processing byproducts, the extraction of carotene from alfalfa, the extraction of protein material from alfalfa, and improved methods for the freezing of poultry and eggs are now at a stage where their pilot plant evaluation should be undertaken. All of these problems are of importance and significance from the standpoint of a more effective utilization of agricultural materials as well as for supplying urgently needed finished products of various types.

(3) An increase of \$71,534 at the Eastern Regional Research Laboratory to continue on an expanded scale investigations on new scientific, chemical and technical uses and new and expanded markets and outlets for apples, vegetables, tobacco, milk products, animal fats and oils, potatoes, hides, tanning materials and leather.

At this laboratory also, additional research projects have now reached a stage where pilot plant scale evaluation of their possibilities is indicated. Specific laboratory projects such as the production of allyl starch, production of synthetic rubber from lactic acid, the production of fatty acids and fatty derivatives of commercial significance from land, and the processing of apples and vegetables are now at a stage where their pilot plant evaluation should be undertaken. In addition, physical testing of the end products resulting from this

research must be carried out particularly with reference to such materials as adhesives, fibers, films and coatings. All of these problems are of importance and significance from the standpoint of a more effective utilization of agricultural materials as well as for supplying urgently needed finished products of various types.

(4) An increase of \$48,695 at the Northern Regional Research Laboratory for expansion of the research on new scientific and technical uses and new and expanded markets and outlets for corn, wheat, and other cereal crops, soybean and other oilseed crops, and agricultural residues.

Specific laboratory research projects such as the production of saccharic acid from dextrose, the fractionation of starch into its components, the production of improved soybean flour, the production of oils suitable for fast drying paint and varnish from soybean oil, the recovery of starch and gluten from wheat flour and the development of motor fuels from agricultural products are now at a stage where their pilot plant evaluation should be undertaken. All of these problems are of importance and significance from the standpoint of a more effective utilization of agricultural materials as well as for supplying urgently needed finished products of various types.

(5) An increase of \$7,103 to meet additional general administrative work in relation to problems of the four regional research laboratories, occasioned by the expanded work to be undertaken at those laboratories.

CHANGE IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

Regional research laboratories: For continuing the researches established under the provisions of section 202(2) to 202(e), inclusive, of title II [, and subject to the provisions of section 393 of title III,] of the Agricultural Adjustment Act of 1938 (7 U.S.C. 1292 [, 1393]), including research on food products of farm commodities [4,244,600] \$4,000,000.

Since funds for the Regional Research Laboratories are provided by a subappropriation under "Salaries and expenses, Bureau of Agricultural and Industrial Chemistry", there is no longer need for the allotment authority contained in the provisions of section 1393 of title III, and it is proposed that the reference thereto be deleted.

WORK UNDER THIS APPROPRIATION

Objective: To develop, by research, new scientific, chemical and technical uses and new and extended markets and outlets for farm commodities, and products and byproducts thereof, such as corn, wheat, soybeans, cotton, sweetpotatoes, peanuts, apples, vegetables, tobacco, milk products, animal fats and oils, tanning materials, hides, skins and leather, potatoes, alfalfa, fruits, poultry, and

agricultural residues. Efforts are concentrated on the development and improvement of processes which will make possible the profitable production of industrial products for which there is a present or potential demand, and to stimulate industries by showing the possibilities of financial profit from the processing of agricultural materials.

The Problem and its Significance: A basic problem and need of agriculture under normal peacetime conditions has been to develop new and extended uses and expanded outlets for its products and byproducts. The war emphasized the importance of the program of industrial utilization of farm commodities, particularly with respect to meeting deficiencies in strategic and critical raw materials and to developing substitute replacement materials of great value for both civilian and military needs. Many low-grade and waste farm materials, as well as food crops, contain appreciable quantities of valuable constituents which serve for the production of plastics, synthetic rubber, motor fuels and lubricants, building materials, cloth filler and substitutes, fibers, protein meals, films, adhesives, medicines, pharmaceuticals, solvents, hormones, and other vital commodities. It is believed that the need for many of these materials will continue through the post-war period, since importation of essential raw materials will not be immediately possible.

General Plan: The research work under this appropriation covers the principal agricultural commodities produced in the 48 States. Through chemical, physical and biological laboratory investigations, it is planned to develop new products or processes involving these commodities, and through chemical engineering research on pilot plant scale, to establish the commercial feasibility of the given product or process leading to commercial development and use of these farm products.

During the war period, emphasis has been placed on the development and improvement, from farm commodities, of products and processes which had immediate significance and application to war needs.

Indicat

Indicated below are the States served, together with the commodities given initial attention, by each of the laboratories:

Southern Regional Research
Laboratory, New Orleans, La.

<u>Area</u>	<u>Commodity</u>
Alabama	Cotton
Arkansas	Sweetpotatoes
Florida	Peanuts
Georgia	
Louisiana	
Mississippi	
Oklahoma	
South Carolina	
Texas	

Eastern Regional Research
Laboratory, Wyndmoor, Pa.

<u>Area</u>	<u>Commodity</u>
Connecticut	Apples
Delaware	Vegetables
Kentucky	Tobacco
Maine	Milk products
Maryland	Potatoes
Massachusetts	Animal fats
New Hampshire	and oils
New Jersey	Tanning materials,
New York	hides, skins
North Carolina	and leather
Pennsylvania	
Rhode Island	
Tennessee	
Vermont	
Virginia	
West Virginia	

Western Regional Research
Laboratory, Albany, Calif.

<u>Area</u>	<u>Commodity</u>
Arizona	Apples
California	Alfalfa
Colorado	Fruits
Idaho	Potatoes
Montana	Vegetables
Nevada	Poultry
New Mexico	Wheat
Oregon	Tanning materials,
Utah	Western Hemlock
Washington	Bark
Wyoming	

Northern Regional Research
Laboratory, Peoria, Ill.

<u>Area</u>	<u>Commodity</u>
Illinois	Agricultural residues
Indiana	Corn, wheat, and
Iowa	other cereal crops
Kansas	Soybeans and other
Michigan	oilseed crops
Minnesota	
Missouri	
Nebraska	
North Dakota	
Ohio	
South Dakota	
Wisconsin	

It will be noted that research on certain of the commodities has been divided between two laboratories. Such division of effort is based on the importance of the commodity under investigation in the regional areas to which assigned. For example: Investigations on wheat at the Northern Regional Research Laboratory deal with wheat starch, wheat oil and their compounds and derivatives, while those of the Western Regional Research Laboratory dealing with this commodity are concerned with wheat protein. The work on apples at the Eastern Regional Research Laboratory is concerned primarily with investigations dealing with juice component of the apples and its derived products such as sirups, concentrates and flavor constituents, while those at the Western Regional Research Laboratory

deal with pectin investigations, freezing, dehydration and related processing operations. The work of the Western Regional Research Laboratory on potatoes is directed chiefly to dehydration studies, while at the Eastern Regional Research Laboratory this work deals principally with potato starch investigations.

All of these joint investigations are closely coordinated and the examples are cited as illustrations of the type of joint approach to utilization investigations of commodities of importance in the various regions concerned.

A composite statement of these joint projects, with overtime excluded from 1944 and 1945 amounts, is given below. Complete project statements for each laboratory appear on subsequent pages.

	: Northern	: Eastern	: Western	:
	: Laboratory	: Laboratory	: Laboratory	: Total
Corn, wheat and other cereal	:	:	:	:
crops utilization investiga-	:	:	:	:
tions (Northern) and wheat	:	:	:	:
utilization investigations	:	:	:	:
(Western):	:	:	:	:
1944 Actual.....	\$513,019	:	\$60,272	\$573,291
1945 Estimated.....	534,690	:	66,340	601,030
1946 Estimated.....	562,935	:	70,348	633,283
Apple utilization investi-	:	:	:	:
gations:	:	:	:	:
1944 Actual	:	\$ 92,083	60,977	153,060
1945 Estimated.....	:	100,500	44,170	144,670
1946 Estimated.....	:	108,540	47,033	155,573
Vegetable crop utilization	:	:	:	:
investigations:	:	:	:	:
1944 Actual.....	:	37,099	308,624	345,723
1945 Estimated.....	:	44,200	267,750	311,950
1946 Estimated.....	:	47,700	280,353	328,053
Potato utilization investiga-	:	:	:	:
tions:	:	:	:	:
1944 Actual.....	:	68,758	47,106	115,864
1945 Estimated.....	:	75,000	59,960	134,960
1946 Estimated.....	:	81,000	63,968	144,968
Tanning materials, hides, skins	:	:	:	:
and leather utilization inves-	:	:	:	:
tigations (Eastern) and	:	:	:	:
Western hemlock bark as an	:	:	:	:
emergency source (Western):	:	:	:	:
1944 Actual.....	:	58,737	13,905	72,642
1945 Estimated.....	:	65,000	7,577	72,577
1946 Estimated.....	:	70,200	8,150	78,350

The research program for each laboratory, by commodities, is briefly discussed in the following statements:

Southern Regional Research Laboratory

PROJECT STATEMENT

Project	: 1944	: 1945	: 1946
	c:	estimated	estimated
1. Cotton utilization investigations	\$685,153	720,700	775,635
2. Sweetpotato utilization investigations..	116,373	126,300	135,914
3. Peanut utilization investigations	48,521	54,171	58,291
4. Overtime costs	110,250	119,429	- -
Unobligated balance	12,898	- -	- -
Total estimate or	:	:	:
appropriation	973,195	1,020,600	969,840

Examples of Progress and Current Program:

Cotton Utilization Investigations: (a) Lint Cotton Investigations:

COTTON TIRE CORD - Research on cotton tire cord, begun in November, 1942, was intensified and broadened in scope during the 1944 fiscal year. This project has continued to receive principal attention in the Laboratory's work on cotton lint since tire cord is normally the most important single use of cotton, and because of the reported superiority of rayon cord over cotton cord for larger size tires, and the War Production Board's order for expansion of high tenacity rayon producing facilities. Activity under this project has had two main objectives: (1) the development of improved cotton tire cords through the experimental selection of commercially available varieties of cotton with properties most suitable for this use; (2) development of improved cotton tire cords through chemical and mechanical treatments of selected available cotton.

Based on fiber properties of various varieties of cotton, three of the commercially available varieties were selected as being particularly suited for tire cord. Cotton of these varieties (SxP, Wilds 13, Stoneville 2B) was spun into yarn at the Southern Regional Research Laboratory and this yarn was later processed into low-gage tire fabrics by Thomaston Cotton Mills. The fabrics were then made into three sets of experimental 7.50-20, S-4 military truck tires by the Armstrong Tire and Rubber Company and tested by the United States Army on test courses at Camp Normoyle, Texas, and Camp Seeley, California. Detailed results of these tests have not been released by the Army for publication, but it can be stated that the tires with cord from two of the cotton varieties far out-performed any other low-gage cotton cord tires so far tested by the Army, and that all three groups performed better than the control tires which were made from a standard cotton cord fabric.

Three other groups of 7.50-20, S-4 military tires made from medium-gage cord are undergoing service tests by the Army at Camp Normoyle. The cord for these tires was made at the Southern Regional Research Laboratory from three selected varieties of cotton. While an observer from the Southern Laboratory is present at these tests, distribution of detailed results is restricted by the Army. Cord is also being manufactured from the variety of cotton that proved best at Camp Normoyle in the first test, for use in experimental 7.00-20, S-4 truck tires and 6.00-16, S-3 passenger car tires for test by a Government Test Fleet. These tires will be tested against similar tires in both sizes made from standard commercial cotton cords, and against a group of rayon tires in the 7.00-20 size.

The problem of developing an improved cotton tire cord by means of chemical and mechanical treatment of selected cotton has been attacked in several ways at the Southern Regional Research Laboratory. As one approach, the swelling and stretching treatments generally used on tire cord in commercial manufacture have been carefully studied. Incidentally, the low-gage cords prepared for tests by the Army were made using a wet-stretching treatment of this type. Although exceptional increases in strength can be obtained by

use of these methods, this is normally accompanied by a decrease in elongation, which can be so great as to render the cord less satisfactory for tires than it would be otherwise. A secondary treatment was developed during the past year, however, which makes it possible to produce a cord of a given elongation and at the same time to maintain the approximate strength of high stretched cords. Arrangements are being made to produce this dual-stretched cord on a pilot plant scale for use in experimental tires.

As another approach, modifications of the mercerization process have been worked out whereby mercerized cotton tire cords have been produced with superior characteristics, as judged by laboratory tests. Arrangements have been made for the manufacture of 600 pounds of mercerized tire cord which it is hoped can be eventually made into tires and tested. These mercerized cords are of particular interest inasmuch as they show an improvement in resistance to heat where it has been claimed that cotton is inferior to rayon in this respect.

As a means of developing basic, scientific data necessary for the development of an improved cotton tire cord, the permanent effect of repeated cycles of temperature changes upon cotton and rayon tire cords has also been investigated. Repeated exposure at low temperatures (-40°F.) showed no significant changes. Very interesting results were obtained, however, after exposure to high temperatures. In this case, the cords were exposed for periods of sixteen hours at a temperature of 265°F. , interspersed with periods of eight hours conditioning under standard temperature and humidity conditions. Both rayon and standard cotton cords suffered a loss of strength and an increase in elongation under this treatment, the measurements being taken after conditioning for twenty-four hours at standard conditions following heating. After the most stringent treatment, forty-eight heatings at 265°F. , the rayon and cotton cords were found to have lost strength to about the same extent, with some variation between different types of each.

As another means of obtaining fundamental, scientific data on tire cord, studies are being made of the reaction of tire cord to different types and conditions of flexing using the two new types of flex testing machines designed by the Southern Regional Research Laboratory. Closely related to this research, are investigations of the elastic properties of tire cord, which are following three main lines of attack: (1) a study of the behavior of cords under constant continuous loading; (2) the measurement of cord relaxation under constant elongation; and (3) a study of cord behavior under cyclic variable loading. The elastic behavior of cellulosic cords at various temperatures has been found to be similar to that shown by rubber and other elastic substances. Rayon and mercerized cotton cords have a considerably greater initial flow than wet-stretched cotton cord but, thereafter, all cords show about the same relaxation rate.

Comparative tests are planned on the adhesion of tire cord to rubber using three different techniques. It has been necessary to modify these techniques to permit measurement at different temperatures and, to date, only

two methods have been used. Results from these tests show that cotton generally has much better adhesion than rayon, if both are untreated. By using the proper treatment, the adhesion of either type of cord can be greatly improved. The relation of adhesion to various factors of construction and treatment is being studied.

SUPPLEMENTING LINTERS - Research on the utilization of lint cotton as a supplementary source of cellulose for the manufacture of smokeless powder, cellulose acetate, and other cellulose derivatives, was undertaken in 1941 when the United States faced a serious shortage of linters. The reduction of lint cotton to lengths comparable to linters was first performed on available commercial cutters that proved inefficient for the purpose. Thereupon a pilot model of an improved type cutter was developed at the Southern Regional Research Laboratory. Subsequently a large experimental machine was designed and has been built. Large scale tests of this cutter are being made with the cooperation of one of the principal linters purification companies. This project is being carried to completion both because of an indicated linters shortage and of official requests by an allied government to obtain lint cotton cutting equipment, and the fact that the new machine has a large number of possible applications in other fields. For instance, a project is definitely planned whereby one unit of the newly developed machine is to be applied to the preliminary processes of cotton textile manufacturing, with expected savings in cost and gains in the quality of the product if results coincide with indications.

In determining the suitability of lint cotton for the manufacture of smokeless powder and other cellulose derivatives, the nitration, acetylation, and xanthation processes were investigated. It was found that if the lint cotton used is of sufficiently good grade, it is satisfactory for any one of these three major processes. In testing cellulose acetate prepared in connection with this investigation, some new plasticizers were developed. Patents have been applied for. During the 1944 fiscal year certain new morpholide derivatives were used for this purpose. In particular the morpholido-phosphates are of interest since they are fireproofing plasticizers.

STABILIZATION OF NITROCELLULOSE - The use of ammonia in the stabilization of nitrocellulose for smokeless powder, a process developed in the Southern Regional Research Laboratory, has been applied with good results to commercial batches of cellulose nitrate. These tests were carried out in collaboration with the War and Navy Departments. Improved methods were developed for the determination of small amounts of sulfate in nitrocellulose and for testing stability. At present long term surveillance tests are being run by commercial manufacturers of smokeless powders on smokeless powder made by cellulose nitrate stabilized by the ammonia process. This new process for stabilization promises considerable savings in time and power consumption during the manufacture of smokeless powder.

RUBBERLESS FIRE HOSE - The process developed at the laboratory for making an unlined cotton fire hose having swelling and water-stopping properties equal to those of unlined linen hose, ordinarily used in standby equipment

for emergency fire protection has been patented. Efforts have been directed toward commercial production of this new type cotton hose and arrangements have been made to weave this product on a standard, firehose loom.

PRESERVATIONS AGAINST MICROORGANISMS - (In cooperation with other Department agencies) The extensive investigation of preservative treatments for sandbag fabrics undertaken in 1940 at the request of the Corps of Engineers, War Department, has been continued in cooperation with the Corps of Engineers and Quartermaster Corps, War Department, National Bureau of Standards, and a Federal Specifications Committee. An extended review of commercial rotproofing treatment is being conducted for the Corps of Engineers and service tests are being made of standard cotton Osnaburg sandbags treated with the more important preservative compounds. In connection with this work, considerable improvements have been made in the technique of soil burial testing, rendering this accelerated method of testing treated fabrics for exposure to weather and microorganisms much more satisfactory and dependable as a test procedure than heretofore.

At the request of the Office of the Quartermaster General, an examination is being made of fungicidal treatments suitable for garment fabrics. Samples of kier boiled cotton twill, a fabric comparable to uniform cloth, have been treated with suitable protective compounds for detailed mildew and weather resistance tests. Various jute and cotton fabric samples have also been protectively treated on pilot plant and laboratory scale for special purposes. It has been demonstrated that the partial acetylation of yarn and cloth renders cotton highly resistant to rotting. Laboratory work has indicated that the continuous acetylation of cotton piece goods by a relatively simple method is an ultimate possibility.

Research is being continued on the furfural resin process, particularly to preserve fish nets and other fishing gear against rotting and microorganisms. Service tests being run in cooperation with the Fish and Wildlife Service have indicated that this treatment is probably superior to all commercial preparations now used for this purpose.

FIREPROOFING COTTON - Investigations of methods of fireproofing cotton, with particular reference to wartime needs, are being made in cooperation with the Office of Quartermaster General, War Department, and in collaboration with work done under National Research Council Project QMC-27 on fireproofing fabrics. The aim is to develop a method which will produce a light-weight air-permeable, flameproofed fabric which fully retains its flame-resistance after repeated launderings. A treatment has been developed by the Southern Laboratory which remains unchanged after many launderings, yet alters the physical characteristics of the fabric only moderately, thus permitting its use for outer garments. For this use one drawback was the rather long duration (four to five minutes) of afterglow after the source of the flame has been removed. It has been found possible to remedy this to a great extent by means of a combination process, the details of which are considered confidential, and a result has been obtained which is believed to

represent, because of its efficiency and permanence, a considerable forward step in the attainment of an ideal flameproofed cotton fabric.

SURGICAL BANDAGE - A special finishing process has been developed to produce improved all-cotton absorbent bandage of the surgical gauze type that is highly flexible and elastic. The bandage has been tried out at the U. S. Navy Hospital and other hospitals in New Orleans and pronounced superior to regular gauze bandage, particularly for head, knee, and elbow dressings. It is easier to apply, readily conforming to body contours, and remains in place better than ordinary bandage. In connection with this development, a study is being made of the principals involved in bleaching, and attention is being directed to designing a special fabric for bandage purposes. Two patent applications covering details of this bandage have been filed.

(b) **Cottonseed Investigations:** Work has continued on the development of replacements for imported fats and oils. A modified cottonseed oil suitable as a replacement for imported cocoa butter, used extensively in food, confectionary, and pharmaceutical products, has been produced by a combination of controlled hydrogenation and low solvent temperature fractionation. Investigations are underway to obtain thermal, dilatometric, and related data on solid and liquid cottonseed oil and on pure synthetic glycerides needed in connection with the various processing operations used in the production of these new products. Processing data for the commercial production of this new fat will be obtained as soon as necessary equipment is delivered and pilot plant research is conducted.

Substantial contributions have been made to methods and processes for improving the keeping quality of oils, fats, and shortenings through studies on the stability of cottonseed oil and the nature of its antioxidants. It has been shown that steam distillation is effective in restoring to a considerable degree the stability of a rancid fat provided phosphoric acid or lecithin is added to the rancid fat prior to deodorization.

Preliminary investigations of the cause of the deterioration of cottonseed in storage revealed the fact that moisture and temperature were the predominant factors, especially in the hydrolysis of the fat to fatty acids. It was found that these were not the only factors involved and that variety, maturity, and certain climatic conditions during growth, maturation, and harvest also influenced the storage life of cottonseed. These factors were found in turn to affect the lipolytic and proteolytic enzyme systems and the respiration of the seed.

Considerable information of a fundamental nature has been obtained on the nature and properties of the constituents of cottonseed and cottonseed cake and meal, particularly on the proteins and enzyme systems. Of

SWEETPOTATO DEHYDRATION - Technical advice and assistance involving climatic and variety problems under this project materially facilitated the design, equipment, and processing control of the new plant of Sweet Potato Growers, Incorporated, for production of dehydrated sweetpotatoes for military food requirements. Intimate experience with the special problems of handling and processing sweetpotatoes was applied effectively in the general plant layout, in the design of the storage, conveying, and preparation units, and in integration of these units with each other and with the dehydrator itself. One major contribution was a continuous lye peeler of unique design, practically automatic and troubleproof in operation. The dehydrator proper, of the multistage tunnel type, was designed and installed by a commercial concern, with collaborative advice. The plant performed in highly satisfactory manner from the start, with a demonstrated output capacity of at least six tons of finished product in 24 hours. While the available raw material was limited in quantity and quality, a production of some 500,000 pounds was achieved and it was practically entirely of first grade.

SWEETPOTATO BYPRODUCTS - The conditions for most effective coagulation of the protein now wasted in the fruit water of sweetpotato starch manufacture were further investigated; and a process for continuous acidification, heating, flocculation, and concentration of the crude protein coagulate has been devised and operated on a large laboratory scale. Crude protein equivalent to 70 percent or more of the nitrogen in the fruit water or around 60 percent of the crude protein in the original sweetpotatoes was thus recovered. The process is being scaled up to pilot plant proportions and the problem of economical separation of the protein concentrate by filtration or centrifugation is under attack. Investigation of the recovered crude protein has accounted so far for over 20 percent of the nitrogen as identified important amino acids. It has further been shown that in the case of high-carotene sweetpotatoes of the Puerto Rico variety, the coagulum thrown down with the protein carries in concentrated form a considerable proportion of the total carotene of the original potatoes.

Continued laboratory investigations have established more definitely the optimum conditions of pH, temperature, and rate of aeration for proliferation of feed yeast, *Torula utilis* on sweetpotato starch fruit water. Previous observations were confirmed in indicating that this fruit water, after flocculation and separation of coagulable material is nearly an ideal substrate for yeast production. Yields of dry yeast equivalent to 40 percent or better, of the sugars present are obtained consistently. With the optimum conditions definitely established, laboratory production of yeast is being scaled up to pilot plant proportions in step with extraction of starch and recovery of protein. Procedures for separation of the yeast and adding it to byproduct feed by means other than centrifugation are being investigated.

Translation of the protein recovery process to the scale of even the small Laurel Plant, with return of the products to the byproduct pulp would save daily around a ton of crude protein now wasted and would raise the protein

of the byproduct feed from the present 2-4% to some 16%. Similar application of the yeast production process would convert soluble sugars now wasted to around a ton or more of high-protein, vitamin-rich, feed supplement. Nearly another ton of yeast a day could be produced from the tailing starch wastes after concentration and conversion to sugars. A tidy sum would be added to the gross byproduct credit in starch manufacture.

On a laboratory scale, the process for extraction and recovery of pectin from sweetpotato pulp has been brought to the point where, after necessary pilot plant development, practical application, with assurance of good yields and high-grade products, appears feasible. Application of recent findings has increased the yield of pectin extracted by 10 to 25 percent with improved quality. Of the varieties of sweetpotatoes so far investigated, the Puerto Rico most readily releases the highest yield of best quality pectin with recoveries up to 1.6 percent of the fresh potatoes or approximately 32 pounds per ton. Integration of the process with other processes providing outlets for the starch and soluble carbohydrates and not requiring lime treatment of the pulp, as in the present starch process, would be necessary for economical exploitation. Prospective developments in use of sweetpotatoes for fermentation products open up attractive possibilities for recovery of pectin, since a direct outlet would be provided for the carbohydrate material.

Peanut Utilization Investigations: The processes for making cocoa butter and olive oil substitutes will be investigated on pilot plant scale as soon as necessary equipment is delivered and installed. The olive oil substitute from peanut oil for use as a textile lubricant, while excellent for the purpose, has not proven as well adapted to sulfonation as olive oil, which requires a lower titer value than the textile lubricant. Experimental work is under way to obtain the information to provide a process for modifying peanut oil to prepare a superior product for sulfonation.

In the effort to increase the stability and reduce the spoilage of edible oils, the natural antioxidants of peanut oil have been examined further. The work has been directed toward the isolation or concentration of the natural antioxidants present in the oil and the determination of the effect of their addition in known amounts to oils practically devoid of these substances. Another phase of the stability work has dealt with the possible means of reconditioning fats which have undergone oxidative rancidification in various degrees. It has been shown that steam deodorization is effective in restoring to a considerable degree the stability of a rancid fat provided phosphoric acid or lecithin is added to the rancid fat prior to deodorization (see Cottonseed Utilization).

In the effort to increase the industrial utilization of peanut protein, the determination of the physical and chemical properties of the nitrogenous constituents of peanut meal has been continued. Information has been obtained on the solubility of protein constituents of the raw product as influenced by concentration, pH, concentration of salts, etc. The effect of processing factors, heat, humidity, and length of treatment during cooking

and pressing operations, on the solubility and properties of the protein have been observed. It is now possible to define the optimum conditions for recovering the maximum yield of specified protein products from solvent-extracted peanut meal. The investigations have been extended to commercially available hydraulic-pressed meals.

The white skinned strains and varieties of peanuts developed by the Georgia Agricultural Experiment Station have shown outstanding superiority over the red skinned varieties for industrial utilization. Prolonged storage before removal of the oil did not appreciably alter the extractability of the protein. The color of the extracted protein was best in the case of the white skinned varieties; poorer in the blanched, red skinned varieties; and worst in the unblanched, red skinned varieties. The white skinned varieties were not found to differ significantly from the red skinned varieties with respect to their protein solubility.

Considerable success has attended the development of adhesives from peanut protein and meal, especially in the field of tacky and re-wettable glues such as used in the manufacture of gummed tape. The glues prepared from peanut protein compare favorably with animal glues and for certain special purposes appear superior to animal glues. The success is based on the development of a method of preparation of a protein hydrate or fusible protein. This product furnishes the basis for a considerable number of unusual protein products. The method of preparation is covered by a patent application and several of the uses of the product are covered in additional patent applications.

Rapid strides have been made in the development of fibers from peanut protein. The wet and dry strength has been steadily increased and the color decreased. Present fibers possess good hand and sheen, dye readily with acid dyes, and can be twisted and knitted on standard textile machines. Several manufacturers have tested the present product and are definitely interested in its utilization even in its presently unimproved state. Further work should greatly improve the properties of the fibers produced.

Western Regional Research Laboratory

PROJECT STATEMENT

Project	1944	1945	1946
		estimated	estimated
1. Apple utilization investigations <u>a</u> /.....	60,977:	44,170:	47,033
2. Alfalfa utilization investigations.....	20,242:	21,720:	29,865
3. Fruit utilization investigations.....	189,617:	230,340:	241,653
4. Potato utilization investigations <u>a</u> /....	47,106:	59,960:	63,968
5. Poultry utilization investigations.....	124,796:	214,730:	228,470
6. Vegetable utilization investigations <u>a</u> /:	308,624:	267,750:	280,353
7. Wheat utilization investigations <u>b</u> /.....	60,272:	66,340:	70,348
8. Tanning materials - Western hemlock	:	:	:
bark as an emergency source <u>a</u> /.....	13,905:	7,577:	8,150
9. Overtime costs	111,560:	120,613:	- -
Unobligated balance	36,696:	- - :	- -
Total available	973,795:	1,033,200:	969,840
Transferred to "Salaries and expenses,	:	:	:
Office of Information"	+ 800:	- - :	- -
Total estimate or	:	:	:
appropriation	974,595:	1,033,200:	969,840

a/ Joint project with Eastern Regional Research Laboratory.

b/ Joint project with Northern Regional Research Laboratory.

Examples of Progress and Current Program:

Apple Utilization Investigations: Research on apples at the Western Regional Research Laboratory has dealt with pectin production from apple wastes, pectin utilization, and with dehydration and freezing as methods of preserving apples.

PECTIN PRODUCTION AND UTILIZATION - Pectin production for 1944 will be about 6 million pounds, approximately twice that of 1941, yet this amount represents the processing of less than 10 percent of the most suitable available pectin source materials, which are citrus rind and apple pomace. With the object of relieving the acute shortage of pectin, work has been practically completed on a process for preparing a good grade of liquid apple pectin concentrate from apple pomace, which accumulates in large quantities in plants where apples are canned, dried, frozen, or otherwise processed. Special consideration has been given to the use of equipment already available in small factories where apples are made into jams and jellies. This process has been described in a mimeographed circular which has been distributed to concerns producing jams and jellies who need a method for making their own supply of pectin. Estimated production costs indicate that this process is commercially feasible. (See also the statement under Fruit Utilization Investigations).

PECTIN PRODUCTS - Pectin produced from apples is for all practical purposes identical with that produced from citrus fruits and can be used interchangeably with these other pectins. The new pectin products described under Fruit Utilization Investigations can be made equally well from apple pectin.

PECTIN AS A SUBSTITUTE FOR BLOOD PLASMA - Progress was being made on the modification of pectin for use as a blood plasma substitute when the National Research Council advised that other substitutes being investigated elsewhere offered more promise. In view of this, the work at this Laboratory was terminated. Even though this work was stopped, fundamental physical and chemical information of value in other pectin research was obtained and has been published.

APPLE DEHYDRATION - The drying of apple slices and of the relatively new "nuggets" (chopped dried apples, dried further to very low moisture contents) has become an important wartime industry. The armed forces use large quantities of these excellent products, equivalent to more than 20,000 tons of fresh apples. This Laboratory's extensive project on all phases of tunnel and cabinet dehydration of fruits and vegetables, including equipment, temperature, humidity, storage, etc., has been directly helpful to processors dehydrating apples. At the request of the Office of the Quartermaster General, studies on the compression of apple nuggets have been carried out with sufficient success to demonstrate commercial feasibility. The compressed blocks save space, can be handled with convenience, and reconstitute satisfactorily.

SPRAY-DRIED APPLE JUICE - Spray drying has large potential value for apple growers and processors because a high grade of apple powder could be stored and shipped economically for use in jams, jellies, beverages, baby foods, bakery goods, and other applications. The new large-sized (pilot plant) spray drier, designed in this laboratory has been received and will be used during the coming year in studies of engineering problems involved in large-scale production.

FREEZING PRESERVATION - Freezing preservation of apple slices, for use chiefly by commercial pie bakers, has more than doubled in quantity since 1942, and research effort has been directed toward prevention of darkening when the slices are defrosted. Scalding or blanching is not entirely satisfactory because it tends to soften the fruit. Dipping in sulfurous acid, while effective, is objectionable because of the offensive odor around the dipping vats. The sodium bisulfite dipping treatment has shown decided advantages and special emphasis has been placed on it. Recommendations have been made to commercial freezers, particularly of Western-grown varieties. Frozen apple slices that can be handled without danger of darkening are attractive to bakers and it seems likely that their production and use will increase further.

Alfalfa Utilization Investigations: Alfalfa, a 285-million-dollar forage crop, is used as a feed in the form of cured hay or meal. Research, pointing the way toward new uses for many agricultural products, sees in alfalfa a potential industrial raw material for the production of pro-vitamin A, chlorophyll (the green plant coloring matter), protein concentrates, and hemicellulosic fibrous material.

Industrial utilization of alfalfa will depend upon the successful recovery of these plant pigments and proteins. Of the plant pigments, carotene (pro-vitamin A) from one ton of high-grade dehydrated alfalfa hay has a value at present wholesale prices of about \$125. Chlorophyll, occurring on the average in about 10 times the amount of carotene, is an undeveloped product with considerable potentialities and value. In addition, there are about 400 pounds of pure protein in a ton of alfalfa which, commercially valued at approximately 10 cents per pound, is worth \$40. Thus alfalfa has a potential industrial value of about \$165 per ton, in addition to the value of the chlorophyll.

Research on alfalfa is being directed toward methods of recovering these valuable constituents. An improved method for the recovery of carotene has been devised. The usefulness of antioxidants as stabilizers of carotene in animal and vegetable oils has been successfully demonstrated. This should stimulate commercial interest in supplementing the present restricted supply of vitamin A. Chlorophyll is used as a green coloring matter in foods, soaps, and pharmaceuticals. Heretofore, recovery of protein, as protein, from green plant material has been regarded as too difficult to warrant consideration as a large-scale operation. A new line of attack in our research on this problem has indicated, in a preliminary way, that it is possible under controlled conditions to recover and concentrate a protein of high degree of purity.

Fruit Utilization Investigations: The large number of kinds of fruit as well as different varieties of each kind, the wide variation in their characteristics and uses, their importance as foods, and the great quantities of waste and byproduct material that result from handling and processing fruits are factors that offer opportunities for research on utilization. The program at this Laboratory includes the following objectives: (1) improved methods for the rapidly growing fruit freezing industry; (2) developing information helpful in the establishment of standard commercial grades of frozen fruits; (3) improvements in quality of frozen fruits; (4) utilization of oils from fruit wastes; (5) simplification of the method of producing pectin and wider utilization of pectin; (6) development of a method for obtaining tartrates from grape wastes; (7) production of vitamin-rich yeast foods and feeds from fruit wastes; (8) production of ascorbic acid (an important vitamin) from walnut hulls; and (9) new and improved methods of dehydrating fruits, including production of spray-dried powders.

"VELVA-FRUIT" - A new method of preparing frozen fruit puree, which results in an essentially new product has attracted widespread commercial attention. A name for the product, Velva Fruit, has been recorded in the Patent Office. By this process purees, which can be prepared from surplus fruit or other sound fruits that are for various reasons unmarketable, are combined with sugar, a small amount of gelatin, and in some cases a small amount of lemon juice or fruit acid flavor; this mix is then frozen in an ice cream freezer. The action of the freezer whips air into the mix and gives the product a pleasing smooth texture. Purees, ready-made mixes, or finished Velva Fruit can be stored for long periods in the frozen state; the natural colors, flavors, and nutritive factors are well preserved. The advantages are (1) a new outlet for surplus fruits including those that because of size, ripeness, or minor blemish, cannot be sold or used in the whole or cut state; (2) a highly palatable and nutritious dessert or confection; and (3) use of the considerable increase in size that certain fruits attain if left on the tree until fully ripe.

Velva Fruit made from cantaloupes provides a promising means of utilizing the large surplus that rots in the fields each year because the fruit matures too rapidly, or because it is blemished, misshapen, or off-grade in size. It is estimated that in one district in California 20,000 tons of ripe cantaloupes are wasted each year.

A COLD PROCESS JELLY - A newly developed product, similar to jams, jellies, or preserves differs however in that the fruit is not heated at any time, and less sugar is required. As a result, the fresh fruit flavor and color are retained and the nutritive values of the fresh fruit, especially vitamin C, are well preserved. Other advantages are (1) the only ingredients are pure fruit puree or juice, sugar, and a small amount of pectin; (2) since heat is not required steam generators and kettles are unnecessary; and (3) since no water is evaporated a higher yield of product is obtained. In the conventional process, 100 pounds of sugar and 100 pounds of fruit make 154 pounds of preserves, while this new cold process yields the full 200 pounds. Over 400 million pounds of jams, jellies, and

similar products were consumed in the United States last year. The same quantity of product could have been made with 23 percent less sugar and fruit by the cold process. Although this new gelled fruit product is preserved by freezing, it will keep for two or three weeks after being defrosted; hence its manufacture, distribution, and utilization are as practicable as those of other frozen products and simpler in some respects.

IMPROVEMENTS IN PROCESSING FROZEN FRUITS - Many fruits, such as apples, peaches and apricots, darken when defrosted. Methods for avoiding this difficulty have been described briefly above for apples. (See Apple Utilization Investigations). Procedures for avoiding this difficulty with other fruits also are being studied and the results reported to fruit growers and processors. The methods studied include pre-treatments with compounds containing sulfur dioxide, scalding in sirup, and handling the fruit in such a way as to avoid exposure to air. It has been found that these methods can be applied after the fruit has been in freezing storage; hence it is possible to store fruit directly from the orchard and hold it for processing later. This has proved commercially feasible.

FRESH FRUIT PRESERVATION - Spoilage of fresh fruit can be markedly delayed by the use of calcium or sodium propionate. Although these compounds check the growth of bacteria, yeast, and molds, they are harmless to man. In fact, they occur rather plentifully in Swiss cheese and have been used for a number of years as a preservative in bread. For example, we have found that fresh figs or fresh boysenberries, when dipped in 12 percent solution of propionate and drained, will keep for over a week in 70° F., while untreated fruit will ferment or mold in 2 or 3 days at this temperature. In crushed or pureed fruit, one-third of 1 percent of the weight of the fruit will lengthen the usual life of the product three or four-fold. This amount of propionate does not affect the flavor of the fruit. Laboratory findings have already been applied in a small scale in commercial usage.

PECTIN PRODUCTION AND UTILIZATION - Two lines of pectin research are receiving emphasis: (1) development of a simplified method of manufacture to alleviate the current shortage and to reduce present cost (85 cents per pound for 100 grade) down to about 25 cents to 35 cents per pound, where pectin would be competitive with industrial colloids such as imported vegetable gums; and (2) development of new pectic materials useful in the war economy and also useful in absorbing the production of the pectin industry in the post-war period.

A continuous method of pectin extraction will probably be given pilot-plant trial during the 1945 fiscal year. A new low-methoxyl pectin product can be used in a variety of low-solids food gels, one of which, newly developed, is a milk pudding that is easily prepared in less than 5 minutes by addition of dry ingredients to cold water. This low-methoxyl pectin and products made with it are of interest to Army officials.

TARTARIC ACID RECOVERY - Ten million pounds (about two-thirds of our normal

consumption) of tartaric acid are annually lost in domestic grape wastes. An ion-exchange method developed by this laboratory for the recovery of tartaric acid from grape wastes yielding a product of high purity was operated on a pilot-plant scale during the Autumn of 1943 and about 11,000 pounds of calcium tartrate were recovered. Additional data are being developed regarding economic evaluation of the method.

YEAST FROM FRUIT WASTES - Methods of growing yeasts on fruit wastes to produce vitamin- and protein-rich foods and feeds have been developed to the point where cooperative commercial-type tests are required to supply operating knowledge and supplies for further evaluation studies. Such tests, cooperative with industry, have been made with both prune and pear wastes.

VITAMIN C FROM WALNUT HULLS - Walnut hulls contain large amounts of ascorbic acid (vitamin C). Exploratory studies have been made on the possible use of the hulls as a source of this important vitamin. Preliminary investigations indicate that a successful and economical method of recovery can be developed.

Potato Utilization Investigations:

DEHYDRATION INVESTIGATIONS - During World War I dehydrated vegetables, chiefly potatoes, were regarded as failures. In this war potatoes are again the most important dehydrated vegetable, accounting for slightly over half of the annual total of approximately 250 million pounds of dehydrated vegetables (processed weight). Armies on both sides are consuming large quantities. Better quality dehydrated potatoes are being produced from the improvements in processing and equipment resulting from wartime emergency research on the problem.

Such investigations have been a major responsibility and accomplishment of this laboratory. They have consisted of (1) the theory of air-circulation dehydration and its application in design and operation of equipment, (2) the drying characteristics of various vegetables and various types of pieces, (3) pretreatments of vegetables, such as scalding and sulfiting, (4) the relation of raw material quality to quality of product, (5) moisture content, (6) packaging, (7) storage conditions, and (8) rehydration. During the past year storage conditions, sulfiting, and compression have received special attention.

At present, because of wartime conditions, it is difficult to estimate or measure objectively the extent to which dried potatoes, produced by present methods, would be acceptable under normal conditions. Serious thought is being given to this question by producers and others and varying opinions have been expressed. Since cost and quality will count heavily, and since efficient equipment and close control are the best means of lowering cost and producing higher quality, these objectives are being stressed in present research.

Poultry Utilization Investigations:

EGG DEHYDRATION - The war has virtually revolutionized our national egg

dehydration industry. Previously it was small, supplying chiefly dried egg white and dried yolk to food manufacturers. There was practically no household use of dried eggs, and little commercial production of whole egg powder. China formerly supplied a large proportion of our commercial requirement of these products.

The change brought about by the war was an increase in production from a few million pounds annually to several hundred million pounds and production for direct consumption in homes, restaurants, and Army camps. Lend-Lease and the armed forces have taken nearly all of the large amounts produced, which are almost entirely whole-egg powders rather than separated whites and yolks.

A technology sufficient for small industry was not sufficient for a large one. Expansion created problems in production, handling, storage and use. It became apparent that the chief end was to attain longer "shelf life" and research has been directed toward that end.

Studies have been conducted and published on retention of vitamins in whole-egg powder under various conditions. Chemical research has been applied in an effort to determine more adequately the nature and causes of changes that the powders undergo during storage, and also to find measures that might be applied to control those changes. A great deal of technical knowledge has been produced and the conditions under which improved egg powders can be stored are better understood. Commercial wartime production continues, but the extent to which this war-developed industry will survive after the war is unpredictable. A large, well established industry is involved and newer technological information will undoubtedly be of value.

The more recent studies have been concerned with compression of egg powder into blocks, methods of determining moisture content, tests to determine quality, the addition of antioxidants, and further chemical investigations of the nature and causes of deterioration. The new laboratory equipment, particularly the new spray drier and vacuum drier, will facilitate research.

BACTERICIDE - Lysozyme, a germ-killing substance that occurs naturally in egg white, has been regarded as to probable value in medicine but has not been extensively studied because of difficulty in obtaining it in pure form. A rapid, commercially feasible method has been worked out in this laboratory; the method has permitted the isolation of the lysozyme in pure form and in sufficient quantity for testing in medical research laboratories.

FIBERS AND PLASTICS - Waste egg white and poultry feathers (and also materials similar chemically to feathers, such as hair, horns, and hoofs) are proteinaceous and are being studied by specialists in protein chemistry. Among their objectives are fibers made from protein materials, and their work on fibers has progressed to a point that justifies elaboration. The fibers produced thus far are similar in structure to natural protein fibers such as wool and silk. Molding powders for plastics are being produced experimentally from similar materials. It is probable that they could be

substituted for a portion of the phenolic resins in commercial molding powders.

PROTEIN FEED - Feathers and similar waste proteins have been chemically changed in form so that they are suitable for use as supplements in feeds. The product obtained has been successfully fed to chickens and rats in small-scale tests. Whether or not the product can be made commercially will depend chiefly on the cost of production. The method of preparation will be published so that those interested in the possibility of industrial development can have the results of the research.

Vegetable Utilization Investigations: Like fruits, vegetables are a diverse and valuable group of commodities, rich in possibilities for development based on research. In normal times, over three million acres are devoted to growing vegetable crops having an annual farm value of about 275 million dollars. Wartime demands have appreciably increased this volume of vegetable production.

The dehydration program in this laboratory offers the possibility of saving surpluses, savings in storage and transport costs, and also convenience for the consumer. It has proved valuable in the war effort. The research of past years and the present projects concerned with freezing of vegetables are of tremendous value to the fast growing frozen food industry. Representatives of this industry are urgent in their appeals for continued research. Here are two important industries, the one a war industry with a need for the further technological development that would facilitate its continuation after the war; the other a successful but comparatively new industry, with a need for research support.

DEHYDRATION - (See Potato Utilization - Dehydration). The dehydration research at this laboratory has reached a stage where it has a substantial foundation of achievement and technical knowledge. Engineering studies of equipment and operation, cost studies, and basic chemical and physical studies applied to commodities in the various stages of dehydration have been carried out. These have resulted in improvements all along the production line - in selection and preparation, blanching, drying, packaging and storage. A new type of vegetable blancher, offering numerous advantages in simplicity, economy, and space saving, has been devised and subjected to pilot-plant and preliminary commercial tests. A 218-page "Manual for Plant Operators" recently published, summarized information for vegetable and fruit dehydrators.

Work during the fiscal year 1944 emphasized storage and its relation to quality and also compression of dehydrated foods into cubes. Methods of compression are now available that can be applied successfully to most of the vegetables being dehydrated. Sulfite treatment for cabbage has now been introduced commercially and has proved successful. Data are being obtained on sulfite treatment for other vegetables. With the achievement of the past few years as a background, it seems probable that further progress can be made. Similarly in research on frozen vegetables, a sound foundation has been built but as the industry expands it will need further and even more

extensive research.

VEGETABLE FREEZING - Work done at the Western Regional Research Laboratory has shown the feasibility of fitting frozen vegetables into the procurement and distribution system prevailing in the larger Army posts. The Army has decided to purchase about 40 to 50 million pounds of frozen vegetables for the fiscal year beginning July 1, 1944. The more frozen foods that can be used by the Army in this country, the more foods preserved in other ways are released for shipment abroad.

Further tests using various vegetables have shown that a simple method of measuring starch content gives a reliable index of the optimum stage of maturity for freezing. This work is important because the quality of frozen peas, for example, is closely related to maturity, and present methods of measuring maturity are not satisfactory to growers and processors. A freezing procedure for tomatoes was investigated and the results published. Packs of soybeans were frozen to provide information on varieties and to measure the effects of various blanching treatments. A method of freezing pumpkin and squash for pies was presented in a mimeographed circular. Numerous other vegetables were frozen in accordance with planned year to year studies, and studies of ordinarily wasted portions, mixed or pureed and combined to make soups or baby foods, were likewise continued.

During processing about half of some vegetables is discarded or wasted. A promising new method of preparing frozen vegetable purees has been developed which utilizes the whole vegetable. The method has the advantages of eliminating vitamin and other nutritional losses and at the same time, eliminates the necessity of pureeing at the peak packing periods, thereby saving a great deal of the food material that would be discarded as waste in normal freezing or canner operations.

ASPARAGUS JUICE CONCENTRATE - From asparagus butt waste a new microbiological medium has been developed within the past two years, one that has become increasingly promising as the research has progressed. Recently, in collaboration with a canning company our investigators have produced sufficient quantity for large-scale use and testing. Small-scale testing in our own and in commercial laboratories has shown that this medium is satisfactory for the production of proteinase, an enzyme preparation used commercially in fermentations, and tyrothricin, an antibiotic or germ killer. Other possibilities have not been fully explored but are under investigation.

Wheat Utilization Investigations: The Western Regional Research Laboratory is responsible for certain phases of the Agricultural Research Administration's program for wheat. Work is being done here on gluten and the protein fraction of wheat.

Probably the most valuable substance that can be obtained from wheat gluten is glutamic acid, a substance having the flavor of cooked meat and for which there is a large demand. A new method for determining the amount of glutamic acid in gluten and other proteins has been published and still another method has been developed and is under test. Such studies are of primary importance in a new industry. Other fundamental investigations are under way which have as their objective an increase in knowledge of physical and chemical characteristics of gluten and other proteins. The ultimate objective is the finding of other industrial uses for protein materials.

These investigations have resulted in the discovery of a method of production of gluten sulfate, which is described in a recently issued public service patent. This new substance, described in previous reports, is now being evaluated by various drug, pharmaceutical, and food manufacturers. It has the unique property of being able to absorb and hold in a stable gel 200 to 300 times its own weight in water. A journal article describing it and suggesting uses has been prepared.

Hemlock Bark Utilization Investigations: Valuable results have been obtained in an investigation in cooperation with the Eastern Regional Research Laboratory of Western Hemlock bark as a source of tannin, necessary in the tanning of hides for leather. A journal article on this work has been prepared.

Domestic tanning supplies have been reduced by the disappearance of the Chestnut, due to blight and foreign sources, (chiefly Quebracho from Argentina), are regarded as being unstable. The Western Hemlock is a domestic source potentially capable of supplying about a third of our national requirement, but development of this large source has been hindered by a lack of suitable technology. Because the logs are floated to the mills, the bark loses a portion of its tannin through leaching. Ordinary methods of extraction are not economical as applied to bark of this kind.

The investigation in this laboratory revealed that subjecting the bark to high pressure in order to remove excess moisture and break up the bark simultaneously followed by leaching and treating of the extract with sulfite, is markedly superior as a method to the process commonly used in the tannin industry. A new type of press, available through cooperation with a commercial organization, was employed in the experiments. Representatives of the Pacific Northwest lumber and pulp industry, who are commercially interested in Western Hemlock, also cooperated, and have followed this investigation with interest, and are planning to engage in developmental work on a large scale.

Eastern Regional Research Laboratory

PROJECT STATEMENT

Project	1944	1945	1946
		estimated	estimated
1. Apple utilization investigations <u>a/</u>	92,083:	100,500:	108,540
2. Vegetable utilization investigations <u>a/</u>	37,099:	44,200:	47,700
3. Tobacco utilization investigations.....	168,524:	181,300:	195,800
4. Milk products utilization investigations	218,897:	242,000:	261,200
5. Animal fats and oils utilization investigations	176,828:	190,306:	205,400
6. Potato utilization investigations <u>a/</u>	68,758:	75,000:	81,000
7. Tanning materials, hides, skins and leather utilization investigations <u>a/</u>	58,737:	65,000:	70,200
8. Overtime costs	110,997:	116,994:	- -
Unobligated balance	21,472:	- -	- -
Total estimate or appropriation	953,395:	1,015,300:	960,840

a/ Joint project with Western Regional Research Laboratory.

Examples of Progress and Current Program:

Apple Utilization Investigations:

APPLE SIRUPS FOR INDUSTRIAL AND FOOD USES - The anticipated manufacture of 20 million pounds of apple sirup in 1943 based on the process developed in this research two years ago was not realized due to the short crop and other unfavorable conditions. Production in the United States was limited to about one million pounds, made partly from byproduct peels and cores. In order to establish more permanent outlets for apple sirup, rather than as a mere wartime substitute for a competing material, products for diversified and specialized markets are being developed in which the unique and specific properties of apple sirup find application. Methods have been developed on pilot-plant scale for the manufacture of four basic types of apple sirup, each of which may be further modified by treatment with invertase or by restoration of flavor. In addition to the present large use as a humectant in the tobacco industry, a great deal of new industrial interest has been shown in the different types of sirup for various purposes. Potential outlets include full-flavored sirup for table use and by the food industry, and bland sirup as a milk modifier and for pharmaceutical purposes. Approximately ten different uses have been found which offer substantial promise for continued expanded outlets for these apple products.

APPLE FLAVOR CONCENTRATE - A continuous process for the effective recovery of a concentrate of "apple flavor" has been developed on a pilot-plant scale. The concentration is 100-fold based on the original juice strength; the deodorized juice remaining after removal of the flavoring constituents is not affected and can be used for further processing - for example, to a concentrate or a sirup. Keen industrial interest has been shown in these recovered flavor products which can be sold as such for use as a flavoring extract or to produce full-flavored apple sirup of various types suitable for table use, confectionery uses, and in commercial baking. They can also be used for producing full-flavored concentrates to be used as fountain sirups or in sherbets.

IMPROVED PROCESS FOR MANUFACTURE OF APPLE BUTTER - For many years "old fashioned Pennsylvania Dutch" apple butter has been made in numerous small plants using simple equipment. This product contains a high ratio of boiled cider to sauce, and thus the yields are low. The time of cooking is long since concentration is slow by the methods used. An apple butter approaching the quality of the "old fashioned Pennsylvania Dutch" type has been developed. It is a tart, full-flavored apple butter of rich brown color and smooth semi-solid consistency. A yield of 8 to 9 quarts per bushel of apples is obtained as compared to 3 to 5 quarts and the time of cooking is reduced to approximately one-third that required by the "old fashioned Pennsylvania Dutch" method. By agitating ground raw pulp browning can be produced within a short time by enzymic oxidation. During this oxidative darkening period conditions are possibly more favorable for the extraction of pectins, and this would account for the fact that better "body" can be obtained in the finished butter. A desirable dark color and

caramelized flavor can be quickly developed by overcooking the butter to a high concentration and then thinning to the final concentration with a portion of the sauce and cider withheld for the purpose. Thus, a product has been developed which can increase the yields obtained by small plant operators with only limited sacrifice of quality. The process should prove useful in lowering costs through introduction of more efficient methods which reduce labor and shorten the time of processing.

Vegetable Utilization Investigations:

VEGETABLE LEAF MEALS FOR ANIMAL FEEDS - In view of tremendous tonnages of vegetable wastes available which at present are being utilized very inefficiently, and because of the acute need for high-protein feeds, particularly in the poultry and dairy industries, considerable effort has been directed to the development of high-vitamin, high-protein feeds from such vegetable wastes. Large-scale drying tests were carried out on various vegetable-waste materials in the process of preparing sufficient quantities of the dehydrated products for future use in feeding or extraction experiments. The wastes divided themselves into two classes according to their behavior in the drier. In Class I are those materials that form a porous bed which readily permits the passage of air; e. g., pea vines and ensilage, carrot tops. In Class II are the wastes that form an impervious bed requiring agitation at intervals during drying; e. g., beet tops, broccoli, turnip tops and lima bean leaves.

The process for recovering the leaf blade portions of all wastes except pea vines consists of flash drying the material, causing the leaf portion to become dry and brittle while the stems remain moist and tough. The drying is promptly followed by trommeling in a rotating screen with stones causing the leaf portion to fracture and pass through the screen, thus effecting a separation from the stems. Chopped pea vines, however, were dried in a rotary drier and the whole dried product was then ground in a hammer mill and screened.

Leaf meals prepared as above were used in feeding trials by the Delaware Agricultural Experiment Station in chick mashes in comparison with alfalfa leaf meal, all used at a level of 8 percent of the mash. The tests showed that these dried vegetable wastes make excellent poultry feed and, where quality control of the dried product has been maintained, are equal to or superior to alfalfa leaf meal. The mash containing the broccoli meal caused the fastest growth. Carrot, lima bean and turnip meals were about equal to the alfalfa, and pea vine was somewhat poorer. The flavor of all the broilers on the leaf meals was good, but that of broccoli-fed birds was unusually fine.

A comprehensive survey was made to determine the availability and distribution of vegetable wastes, especially those which were known to be sources of high-vitamin, high-protein feeds. This information is of particular value in connection with efforts now underway to secure large-scale commercial production of vegetable-waste feeds. Since pea vines represent the

largest single item of waste in the vegetable industry, further intensive effort is being made to improve the drying process for this product in order to avoid the loss of quality encountered in the experimental work during the past season. This outlet should have a wide application, both geographically and to a wide variety of raw materials.

CAROTENE FROM VEGETABLE WASTES - Laboratory investigations on the extraction of carotene and other lipoidal constituents from vegetable-leaf meals were brought to successful completion during the past year. Carotene crystals, carotene in the natural oils from vegetable leaves, and carotene solutions in vegetable-seed oils were prepared. A large-scale laboratory extraction procedure was worked out as a preliminary to pilot-plant extraction studies now underway.

Tobacco Utilization Investigations:

OIL-SOLUBLE NICOTINE INSECTICIDES - During the fiscal year 1944 a new series of oil-soluble water-insoluble nicotine compounds was developed. The successful synthesis of these new nicotine derivatives represents a significant advance in the chemistry of insecticides and, depending on final entomological tests, may afford a much broader basis for the utilization of nicotine.

Nicotine products having good oil solubility with low-water solubility have long been sought as a means of overcoming the limitations of known nicotine compounds as insecticides. Preliminary tests indicate that the new materials are at least as toxic as nicotine or nicotine sulphate. Moreover, the oil-soluble compounds containing copper as part of the molecule possess appreciable fungicidal activity. In cooperation with the Geneva, New York, Agricultural Experiment Station and the Bureau of Entomology and Plant Quarantine large-scale orchard tests have been undertaken. Considerable industrial interest in the new insecticides has been manifested and independent field tests are underway. In anticipation of future developments improved methods were devised for the large-scale preparation of the oil-soluble products in concentrated form and in oil solutions.

INSOLUBLE NICOTINIC ACID PRODUCTS - Previously in this work two new catalytic methods were developed for the production of nicotinic acid and nicotinamide (anti-pellagra vitamin) from nicotine. During the fiscal year 1944 there was disclosed a need for a water-insoluble form of nicotinic acid or its amide for the fortification of corn grits and other food products which would not be subject to loss through washing prior to cooking. Fourteen water-insoluble forms of both nicotinic acid and nicotinamide were synthesized and are now under test in cooperation with the National Research Council. At least one of the insoluble compounds has been shown to have unimpaired anti-pellagra activity and its application to corn grits is being tested. This idea of application would not only make possible a broader and more efficient utilization of this important dietary factor but may also have significant social and economic importance in areas where pellagra is common.

RUTIN FROM TOBACCO - It was previously reported that rutin, a glucoside occurring in flue-cured tobacco, which had been tested clinically in cooperation with the University of Pennsylvania Medical School, had been found to be effective in treating diseases associated with increased capillary fragility and of significant value in preventing apoplexy and retinal hemorrhage due to hypertension accompanied by increased fragility of the capillaries. During the fiscal year 1944 a much larger number of clinical cases were treated with rutin, confirming the previous findings. The significance of rutin in medical practice is due to its action on the walls of the minute blood vessels termed capillaries which in some diseases become brittle and permit blood to break through, forming small hemorrhages. In such conditions high blood pressure tends to increase the hemorrhages and, if these occur in the eye or brain, blindness or even apoplexy may result. By combining rutin with remedies for high blood pressure, definite improvement may be obtained in a shorter time. This type of action was formerly thought to be due to ascorbic acid, Vitamin C, but further study demonstrated that it did not actually possess this power. Further clinical tests are being carried out at the University of Pennsylvania's Medical School looking to the possible use of this substance in certain cardiac diseases, in the treatment of asthma and hay fever, and in the prevention of X-ray burns.

Studies were continued to develop an improved method for the extraction and recovery of rutin from tobacco. A satisfactory procedure involving fractional extraction with alcohol was devised and improvements were also made in methods for its purification. Two large drug companies have become interested in manufacturing rutin based on the research findings reported here.

Milk Products Utilization Investigations:

PROCESS FOR LACTIC ACID RECOVERY AND PURIFICATION - Lactic acid produced by bacterial fermentation of whey and other carbohydrates is a raw material of great potential importance in extending the industrial utilization of these agricultural products. From lactic acid stems a whole series of chemical intermediates known as acrylic acid esters or acrylates which have unique properties making them suitable for the manufacture of plastics, synthetic rubber, adhesives and coatings. Many other potential applications of these products can be foreseen which promise a broad and extensive basis for the utilization of lactic acid. Competing synthetic processes for production of the acrylates make it important that the costs of the several steps involved in the process of converting lactic acid to the acrylate be reduced to a minimum. Because lactic acid recovery and purification processes now in commercial use are complicated, inefficient and expensive, considerable attention has been devoted to this problem during the past year. A new process applicable to the recovery of lactic acid from dilute fermentation liquors has been devised which should have an important bearing on the whole problem of lowering production costs. The process consists of passing methanol vapors through the heated lactic acid solution containing a suitable catalyst, condensing the methyl lactate and hydrolyzing and recovering the resulting lactic acid and methanol. Much indus-

trial interest has been shown in the process.

PLASTICS AND SYNTHETIC RUBBER FROM LACTIC ACID - Considerable further progress has been made in the preparation of plastics and synthetic rubbers from lactic acid derivatives. Several new synthetic rubbers have been developed from: (1) copolymers of acrylic esters and polyfunctional monomers, (2) copolymers of acrylic esters and certain monofunctional monomers, and (3) polyacrylic esters. The first type includes copolymers of dienes, ethers, esters, or other compounds which furnish unsaturation. The second type consists of saturated copolymers having reactive groups such as halogen, cyano, phenyl, or nitro groups for vulcanization. The third type is vulcanizable without sulfur; the other types are vulcanized with or without sulfur. These materials have exceptional resistance to oxygen, sunlight, natural and high temperature aging, oils and gasoline. Further evaluation to establish specific applications is being prosecuted intensively.

PROTEIN BRISTLE FIBER - In view of the continued shortage of natural bristle, limiting its use to only the more critical needs, investigations have been continued throughout the past year to place casein bristle in the position of a satisfactory substitute material. Considerable attention has been given to the development of a production method whereby the fiber could be extruded, stretched and hardened continuously. While this has not yet been completed it is believed that quantity production can be achieved with continuous extrusion followed by batchwise stretching and hardening. The dry strength of the present casein bristle, which is about two-thirds that of natural bristle, is considered adequate for most uses. Greater flexibility and water-resistance are needed for universal application of the fiber. A distinct advantage of the casein bristle over the synthetic bristle used in some brushes now being marketed is its general inertness toward organic solvents and oils.

Although representatives of several industrial companies have given generally favorable opinions of the casein bristle fiber, it has not been possible to secure adequate appraisal of the product for use in either dry brushes (e. g. counter brushes) or in paint brushes. Difficulty was encountered in each case in attaching or imbedding the bristles. For example, one lot of bristle was imbedded in unpolymersized bakelite resin and then subjected to heating to effect polymerization of the imbedding material. The raw resin, containing free phenol, attacked the bristles such that they broke easily at the point of attachment. However, it has been shown possible to secure a relatively satisfactory imbedding with rubber vulcanized under carefully controlled conditions. It is obvious that the properties of casein bristle are not identical with those of pig bristle or horsehair and consequently modified imbedding techniques must be found. Few, if any, bristle jobbers or brush manufacturers have suitable experimental facilities and it will therefore be necessary as part of this work to find proper imbedding agents for the protein bristles.

PROTEIN TEXTILE FIBER - Significant physical and chemical factors affecting the quality of textile fiber made from casein have been appraised. Thus,

under given experimental conditions, the contributions of stretch to increased tensile strength and of hardening treatments to stability in boiling water were determined. Also the requisite conditions for acetylating casein fiber to give maximum "boil" resistance without fiber degradation were worked out. Since a considerable fraction of the casein textile fiber produced in this country goes into the felting of men's hats, some investigation has been made of the felting characteristics of the experimental fibers and of methods of improving these characteristics. The felting tests have been performed by courtesy of the John B. Stetson Company, Philadelphia. Some of the samples, when mixed with fur in equal proportions, have given a felt swatch of improved feel and good felting rate. Further necessary tests are being conducted on these samples.

PROTEIN PLASTICS - Casein plastics are conventionally made by extruding and shaping the water-plasticized protein and finally hardening the article in aqueous formaldehyde. The continuing objective of the research program on the development of casein plastics has been to devise procedures for the preparation of a modified protein material which could be directly molded to give a satisfactory final product. This molding material must, of course, flow well in the mold; and the final product should have good strength, should not be brittle, and should have a relatively low absorption of water. It has been found possible to reduce the water absorption (content) of formaldehyde-treated casein, which is about 30 percent at saturation in water, to half this figure either by acylation of the casein or by introduction of water-insoluble plasticizer. Other methods have been developed which yield a plastic of relatively high tensile strength (around 10,000 p.s.i.). The problem remains to simultaneously incorporate these several improved properties in an economic product.

Animal Fats and Oils Utilization Investigations:

IMPROVED SOAP EMULSIFIERS FOR PRODUCTION OF SYNTHETIC RUBBER - As soap emulsifiers in G-R-S (Government Rubber type S) polymerization are of great importance in the synthetic rubber program, studies were carried out during the fiscal year 1944 looking to improvement of the uniformity and effectiveness of tallow soaps used in the production of synthetic rubber. The studies were conducted at the request of the Rubber Reserve Corporation and in collaboration with several universities, industrial organizations, and other Federal agencies. The special phases of the work carried out under this project involved the preparation of purified samples of certain fatty acids from which the pure soap emulsifiers could be prepared, the preparation and collection of certain naturally occurring antioxidants so that the effect of each on the polymerization reaction could be determined, and the development and application of satisfactory spectrophotometric methods for analyzing the tallows being used. One of the chief obstacles to successful progress in determining the constituents of tallow soaps responsible for the deleterious action during the polymerization reaction has been the lack of accurate and reliable analytical methods for the determination of the highly-unsaturated fatty acids occurring in the soap. The use of ultraviolet absorption spectrophotometric procedures appeared to give more accurate and

reliable analyses. These findings will also have important application in the plastic industry.

The results obtained in these collaborative studies carried out so far indicate that the presence of antioxidants in concentrations normally encountered has no deleterious effect on the polymerization reaction. It was found that removal of most of the highly-unsaturated fatty-acid constituents from the soaps by means of partial hydrogenation gives a product of greater uniformity and increases the yield of synthetic rubber (GRS) by approximately 20 percent. Moreover, the requirements of the industry can now be met through the use of inedible tallow stocks whereas prior requirements dipped heavily into limited edible supplies. The application of these results will be of great value to the synthetic rubber industry which consumes approximately 90,000,000 pounds of tallow annually.

PREPARATION OF USEFUL PRODUCTS FROM ANIMAL FATS AND OILS - In connection with studies carried out for the purpose of preparing useful products from animal fats and oils, considerable progress has been made in determining the mechanism of air oxidation of methyl oleate which promises to be of considerable value in the development of methods for the preparation of valuable and needed industrial chemical intermediates from fats such as azelaic, pelargonic and hydroxystearic acids. Studies on the sulfation of oleic and linoleic acids indicate that mixtures of monohydroxystearic acids can be obtained by the sulfation procedure and that such mixtures may have technical applications. A process for their isolation based on conversion to esters and fractional distillation has been worked out. Esters of hydroxy acids have been prepared and their properties determined with a view to their use as components of high melting waxes. Work has also been carried out on the preparation of epoxystearic acid and other epoxy compounds. These epoxy compounds are very reactive, and a number of highly interesting derivatives can be made from them.

IMPROVEMENT OF STABILITY OF LARD - Investigations on the use of various materials as antioxidants for fats and oils have been extended, and it has been found that due to development of undesirable flavor, odor and color during room storage the concentration of added antioxidants should be kept at a minimum level consistent with attainments of the desired stability.

By virtue of arrangements made through the American Meat Institute, pilot-plant trials of a number of antioxidants for use with lard have been completed. These tests have yielded valuable information regarding difficulties to be anticipated in commercial operations. Preliminary examination of lard stabilized in a pilot plant by the use of tocopherol and nordihydroguaiaretic acid (NDGA) with synergists indicates that commercial production of lards having high stability is feasible. The cost of the antioxidants per pound of lard is estimated to be about $\frac{1}{4}\phi$. No appreciable operational cost is involved unless deodorization, bleaching or other processing is desired. Satisfactory conditions can usually be found for deodorization and incorporation of the antioxidants whereby a bland, odorless lard of good color and stability can be produced. This is of considerable

importance in placing lard in a more favorable position with respect to vegetable shortenings, since the trend in consumer's preference seems to be towards bland shortenings. Further large-scale tests are being made in cooperation with the Quartermaster Corps of the War Department in which the stabilized products are subjected to extreme climatic conditions.

Potato Utilization Investigations:

PRODUCTION OF ALLYL STARCH - Studies on the preparation, properties and utilization of derivatives of potato starch have been focused largely on the development of more practicable methods of preparation of allyl starch and its evaluation for various industrial uses. Allyl starch when freshly prepared is a gummy material readily soluble in a variety of organic solvents. Its properties are such as to make it appear promising for wide application in the fields of protective and decorative coatings and laminating materials. A great deal of industrial interest in this new product has been manifested.

A practical method of preparing allyl starch has been developed which consists of direct allylation of the starch under pressure. Since the reaction is very simple to carry out, and both starch and allyl chloride are comparatively inexpensive raw materials, it would appear that allyl starch can be manufactured at a comparatively low price, which will place it in a very favorable position with respect to competitive products in the protective coatings and laminating materials fields.

PROPERTIES AND USES OF ALLYL STARCH - Considerable progress has been made on the evaluation of allyl starch for various uses. The most promising application, however, is its use as a coating material. When applied from a solution to a surface of wood, paper, or metal it forms a smooth glossy coating. When subjected to heat, or on long standing, this coating becomes very resistant. It is insoluble in all common organic solvents, is extremely hard, is not affected by temperatures up to 390° F., and resists the action of hot oils and moderately concentrated acids and alkalis. It has been demonstrated that allyl starch possesses properties which make it particularly suitable for use as the basic ingredient of a spirit varnish. Its utilization as a shellac replacement is also being investigated.

An isobutyl alcohol solution of allyl starch has been found to be a satisfactory experimental lacquer for brush application, while the same solution diluted with 50:50 isobutyl alcohol and Varnish Makers and Painters naphtha is suitable for spray coating. The lacquer dries free from tack in a few minutes and a second coat can be applied within an hour. After eighteen hours of drying the film is sufficiently hard to permit sanding and finishing. Considerable time would be required for allyl starch film to attain maximum hardness by air-drying. Oven baking, however, produces a hard resistant film in a comparatively short time (4 hours at 212° F.).

A rigid plastic molding compound has been prepared from allyl starch by compounding and curing under optimum conditions according to a modified

hard rubber recipe. The resulting product exhibited considerable brittleness. Modifications utilizing reinforcing agents, that is, clay, carbon black, etc., did not sufficiently improve tensile properties. It has not been found possible to date to reduce the brittleness of the vulcanizate by the addition of plasticizers without too great a sacrifice in tensile strength. However, usefulness is indicated in the field of laminated plastics, where the physical properties of the web, i. e., paper, cloth, asbestos, etc., complement those of the allyl starch. Experimental paper laminates have been made by impregnating kraft paper with an allyl starch laminating varnish containing sulfur and a vulcanization accelerator. The impregnated sheets were compacted and cured in a hydraulic press. The resulting laminate was found to have tensile properties within the range of commercial phenol formaldehyde paper laminates.

Tanning Materials, Hides, Skins and Leather Investigations:

DEVELOPMENT OF MOLD RESISTANT TREATMENTS FOR LEATHER FOR MILITARY USE - In cooperation with the Army Ordnance, War Department, tests have been conducted to discover what treatments might be used to render Army carrying cases resistant to the action of molds and mildews. Of nine treatments applied, one employing "Shirlan Extra" (Salicyl anilide) as the fungicide and paraffin wax to impart water-resistant properties appeared to be particularly good. Other equally effective treatments were not considered suitable because they employed materials which might be toxic to humans or might cause corrosion of metallic parts of the instruments. "Shirlan Extra" is not effective without wax and it appears that some substance such as paraffin must be incorporated in the treating material to make it effective. Tests are being carried out to determine how treated cases containing instruments would withstand elevated temperatures such as might be encountered in the hold of a ship and whether such temperatures would lessen the effectiveness of the treating materials. If this treatment withstands the conditions of these tests, it is planned to include it in Army Specifications for leather carrying cases. Studies are also being conducted, in cooperation with the Quartermaster's office, for improvement of the serviceability of insole leathers for Army shoes; and of the composition of captured German, Italian and Japanese army shoes and boots.

CONSERVATION OF HIDES AND SKINS - The utilization of every possible means of conserving and increasing the available supplies of hides and skins is essential because of a shortage of these raw materials for leather manufacture. As a contribution to this program through use of better methods of handling and preserving hides and skins, two mimeographed circulars, BAIC-24 and BAIC-25, were prepared and distributed to schools for slaughterhouse operations conducted jointly by the Farm Credit Administration and the United States Office of Education at seven packing plants in the East and Middle West. The circulars describe proper methods for skinning cattle and curing the hides and the prevention of waste in hides and the resulting leather caused by cuts, scores, spoilage, and other damage resulting from poor workmanship. Marked reduction in damage to hides has been noted in plants where schools have been conducted.

NEW SOURCES OF DOMESTIC TANNING MATERIALS - Because of the increased demand for tanning materials to manufacture the large amount of leather needed for military and essential civilian use, every effort is being made to develop new sources of domestic tanning materials. Substantial progress has been made on the development of a number of these domestic sources of tannin.

Field studies on growing of canaigre as a tannin crop have been carried out in cooperation with the Bureau of Plant Industry, Soils and Agricultural Engineering with good progress being made on development of high-tannin strains and increased yields per acre. About 16,000 pounds of the roots were harvested during the year, which permitted carrying out of studies on a pilot-plant scale to determine optimum conditions for artificial drying and shredding of the root. Progress has also been made in experimental tannages using powdered canaigre roots for direct tanning. In the opinion of the tanner who carried on some of these tests, canaigre produced better results than tara and gave a retannage that compared favorably with that obtained with Sicilian sumac. Powdered canaigre has also been successfully used to replace quebracho or oak in direct tanning of pickled sheepskins for hat-band leather.

Definite progress has also been made in studies on development of other domestic sources of tannin, which include the following: sumac, scrub oak bark, Sitka spruce bark, Western hemlock bark, and Lespedeza.

Northern Regional Research Laboratory

PROJECT STATEMENT

Project	1944	1945 estimated	1946 estimated
1. Agricultural residues investigations...	184,455	193,228	203,453
2. Corn, wheat and other cereal crops			
utilization investigations a/.....	513,019	534,690	562,935
3. Soybeans and other oilseed crops			
utilization investigations	116,863	193,227	203,452
4. Overtime costs	106,079	121,855	- -
Unobligated balance	53,979	- -	- -
Total estimate or appropriation	974,395	1,043,000	969,840

a/ Joint project with Western Regional Research Laboratory.

Examples of Progress and Current Program:

Agricultural Residues Utilization Investigations:

The development of new materials from agricultural residues to supply both wartime and peacetime demands for substitute materials offers many possibilities. During the year, representatives from Canada, Australia, Egypt, Sweden, Chile, Peru, Brazil, China, and India, as well as many of our own citizens, have called at the Laboratory to consult with us on various commercial uses of agricultural residues. These visits were partly due to announcements of successful projects, but largely reflect the growing belief that world economy requires some money return to the farmer for this large portion of his total crop.

A number of the problems undertaken as emergency measures have been successfully completed or are nearly terminated. The following projects are representative of definite accomplishments.

SOFT GRIT BLASTING MATERIALS - Based on work by the Northern Regional Research Laboratory, the U. S. Navy Department has standardized the use of ground corncobs for use as soft grit material in the air blasting of carbon from airplane cylinders and pistons. This use of soft grit in an air blast of 80 to 90 pounds pressure is a war development and replaces the previously used chemical and mechanical methods of removing carbon and oil particles baked on to high compression engine parts. Many materials have been used for this purpose, including cracked wheat, corn grits, clover seeds, cellulose acetate pellets and, later, ground apricot pits. Ground corncobs have been found the most suitable by the Navy. The particles last from 5 to 10 times longer than corn grits formerly used, and polish the metal parts during the cleaning operation.

Hybrid seed cobs represent the preferred raw material source, since these are already dried in the seed houses. The Northern Regional Research Laboratory has given assistance in the design of engineering plant details and preliminary tests to large hybrid seed producers interested in manufacturing soft grit cobs in commercial quantities for military and other needs. It would appear that these studies are the basis of a new war and post-war industry.

CORK SUBSTITUTE - The Northern Regional Research Laboratory has developed a new material known as Noreseal, to be used as a substitute for cork in the beverage and other industries. This material has aroused wide interest among both the bottlers and the cork manufacturers. At least three manufacturers are considering the production of Noreseal, and others have indicated their desire to manufacture when the pilot plant studies now underway are completed. Two pilot plant operations are under investigation: One, a method of producing sheet Noreseal for which a pilot plant, having a capacity of 150,000 discs per hour, has been built by a trade association in Peoria, Illinois; and the second, a method of dispensing into individual crowns by means of an automatic dispensing machine. Preliminary cost estimates indicate that Noreseal may survive competitively as a post-war production. At the present time, the cork situation is

critical and every effort is being made to complete this industrial development.

FERMENTABLE SUGARS FOR ALCOHOL AND BUTYLENE GLYCOL MANUFACTURE FROM AGRICULTURAL RESIDUES - This project has been continued during the past year and has received intensive study with a view to developing basic data which could be used for the designing and operation of a semi-works plant with a capacity of one ton of glucose per day.

Fundamental laboratory studies have shown that it is possible to separate the products of saccharification into three basic products, xylose, dextrose, and lignin. Based on these fundamental studies, process steps have been carried out on a laboratory pilot-scale using, in all, about one ton of corncobs as raw material.

The process being developed will be continuous in operation and will produce three materials: (1) A xylose solution in a concentration of 12 to 17 percent from which fermentation products may be derived, xylose may be crystallized and from which furfural in high yield may be obtained by pressure distillation with acid; (2) a dextrose solution in concentration of 10 to 12 percent which may be directly fermented by yeast to alcohol or by Aerobacter aerogenes to 2,3-butylene glycol using a small addition of steep liquor to supply growth factors or be used as raw material for a wide range of other fermentations; (3) a dry granular lignin residue.

The best cost estimates that can be made on the basis of our laboratory-pilot experiments indicate that fermentable glucose should be capable of manufacture at less than one cent per pound, which will permit competition with blackstrap molasses in industrial fermentation processes provided the furfural produced from the pentosan fraction sells at 7.5 cents per pound or xylose sugar in place of furfural sells at 6 cents per pound. This cost estimate contemplates the use of lignin as boiler fuel. If uses can be found for lignin which justify sale at $\frac{3}{4}$ to one cent per pound, the cost of glucose will be lowered.

Corn, Wheat, and Other Cereal Crops Utilization Investigations:

Cereals are the cheapest starchy agricultural commodities in the United States. They are used primarily as human food, as feed for the production of livestock and poultry, and for industrial purposes. Their production and utilization therefore play an essential role in the economy of this country.

The total annual domestic production of all cereals averaged 114 million tons in the 1929-38 period, while in the period 1941-43 annual production averaged 143 million tons. Corn alone accounts for approximately one-half of this tonnage and wheat for one-fifth. In spite of the tremendous increase in production during this war period, a shortage of cereals exists because of augmented demands for feed, food, industrial, and Lend-Lease purposes. Carry-overs of all cereals are being reduced, and those of wheat and corn are falling to particularly low levels. Adjustments in the utilization of cereals have therefore become necessary.

All cereals are quite similar from the standpoint of their composition. Their main constituent is starch which generally represents from 50 to 75 percent of the whole kernel, while the protein varies from about 8 to 20 percent, and the oil content from 2 to 5 percent. The physical characteristics of the protein and minor constituents exert a powerful influence on specific uses and account for consumer preference of a particular cereal. In the case of wheat, the doughing characteristics of the protein are responsible for its wide usage as a breadstuff. For some uses, the cost of the starch in the cereal will be the main factor which will determine its use. Thus, for fermentation and for starch production, the cheapest cereal on the basis of its starch content is usually utilized. Under ordinary conditions, this is corn. Barley, on the other hand, because of its powerful saccharifying action on starch, is used primarily for malting purposes. Because of the similarity in the composition of the cereals, they can, for many feed, food, and industrial purposes, be used interchangeably.

Important researches have been conducted on the industrial and food utilization of cereals. Deficiencies in strategic and critical raw materials, such as rubber, imported starches, and drying oils, have led to the development of replacement materials. The shortage of corn for alcohol, starch, and sirup production has been met by the substitution of the more abundant cereals, wheat and rye. Rubber substitutes and extenders from starch, films and fibers from the protein of cereals, starch and sirups from wheat to supplement corn starch and sirups, motor fuels, replacements for imported adhesives, vital war chemicals, starch sponges for deep wounds and for high-energy "K" rations, and a new therapeutic agent for war wounds, are fields in which work is now in progress.

PENICILLIN - The growth of the penicillin industry during the past year has been one of the most remarkable developments in the whole war production program. From a figure of approximately 100 million Oxford units produced in May 1943, the production of this invaluable therapeutic agent increased a thousandfold to 100 billion units in May of 1944, and exceeded 200 billion units in October of 1944. To accomplish this tremendous production, a total of 21 plants have been or are being erected in the United States and Canada, varying in capacity from 1 to 70 billion units per month.

The contributions of the Northern Regional Research Laboratory to this tremendous development can be divided into three categories: (1) The development of new and better organisms. All plants now producing penicillin in this country are using particular strains of mold developed in the Northern Regional Research Laboratory, and continuous study is being devoted to the improvement of these strains both for surface and submerged work. (2) The discovery of superior operating conditions for the actual fermentation. The most important has been the incorporation in the culture media of corn steeping liquor, a byproduct of the cornstarch industry. This has resulted in an increase of penicillin yields amounting to 30- to 40-fold and a demand for 12 million pounds of corn steeping liquor for the calendar year 1944. In the second place, lactose (milk sugar) was found to be decidedly

superior to any other easily available sugar for the production of penicillin. Five and one-half million pounds of lactose are being used for the production of penicillin in 1944, and 7 million pounds will be needed for 1945. (3) A third contribution to operating conditions made by the Laboratory cannot be disclosed. The Laboratory has made a contribution to recovery methods which was deemed of sufficient importance to be covered by a secrecy order, so it cannot be discussed here.

To sum up the Laboratory's contributions to the penicillin industry, yields in surface cultures have been increased from 2 Oxford units per cc. in July 1941 to 300 units per cc. in 1944, a 150-fold increase. At the same time, it has been found that penicillin can be grown in submerged culture, a much more practicable method, with yields of 150 to 175 units per cc. Finally, in part as a result of the Laboratory's research and consulting activities, the penicillin industry is now producing ample amounts of material for the primary purpose in view, the saving of arms and legs and lives of the men in the front lines..

2,3-BUTYLENE GLYCOL TO BUTADIENE - The 2,3-butylene glycol-butadiene process, developed at the Northern Regional Research Laboratory, has reached the stage where, at the request of the Office of the Rubber Director, a firm of construction engineers has prepared a comprehensive report, accompanied by preliminary plant design and cost estimates of construction and operation for a plant with a capacity of 10,000 tons of butadiene per year. The various steps of the process may be summarized as follows:

- (1) Fermentation - It has been demonstrated that carbohydrates can be fermented to 2,3-butylene glycol by the organism Aerobacter aerogenes. Yields as high as 14-1/2 pounds per bushel of grain have been obtained in the pilot plant and in fermenters up to 8,000 gallons capacity. Fourteen pounds per bushel is the figure accepted for plant design.
- (2) Recovery - The recovery of butylene glycol has proved to be an exceedingly difficult problem. After a study of various methods, it has been shown that the steam stripping process is entirely practical for continuous operation and is the basis of plant design. Steam costs have proved to be low since steam can be recycled, and glycol recovery is 95 to 97 percent. Examination of the byproduct feed for vitamin content indicates suitability for high priced poultry feed supplements..
- (3) Esterification and Pyrolysis - Esterification and pyrolysis of butylene glycol to butadiene have been studied on the basis of a 100-pound-per-day pilot plant and also in a one-ton pilot plant. Yields in both have been obtained on the basis of butylene glycol amounting to 85.4 percent of butadiene of 99 percent purity.

CONCLUSION - Much of this work has been done in cooperation with commercial organizations. Two outstanding factors recommend the butylene glycol process as compared with the alcohol process: One, the very high purity of the butadiene, thus avoiding costly and complicated purification steps; and,

two, a higher over-all yield. Assuming 14 pounds of glycol per bushel of corn, .95 percent recovery, and a 85.4 percent conversion of glycol to butadiene (all figures based on actual results), a yield of 6.82 pounds of butadiene per bushel of corn is obtained as compared with 6.3 pounds by the alcohol process..

WHEAT STARCH - The Northern Regional Research Laboratory has developed a new process for separating wheat flour into starch and gluten. This process involves the conversion of flour into an elastic, free-flowing batter by appropriate mixing of a critical amount of water with flour. Separation of this mixture is effected by passage over a vibratory screen. The starch milk which passes through the screen may be used directly for fermentation or conversion to sirups or crystalline dextrose. Depending on the drying process used, the gluten is suitable for fortifying low-protein flour for breadmaking or for utilization in other food products.

The advantages of the process lie in the speed and simplicity of operation which requires no chemicals, and practically complete recovery of the wheat gluten in an undevitalized state if desired. Another great advantage is that this process can be used in beet sugar factories and sugar refineries for the production of starch for conversion into sweetening agents without the addition of any large quantity of new equipment. One organization, a beet sugar refinery, is producing 10 million pounds of wheat sirup monthly, the byproduct gluten being used for monosodium glutamate.

During the past decade soft wheat has been a burdensome surplus in the Pacific Northwest, and its price has approximated, and, in some years, even been less than the Chicago market price of corn. In that region, the production of starch and sirups from wheat appears to be particularly attractive from the long-term standpoint.

STARCH SPONGES - Starch pastes become highly absorptive when slowly frozen. The Northern Regional Research Laboratory has found that sponges thus formed have properties which suggest their use as dressings in deep wounds and operative cases. They are very absorptive, soft, pliable, and gradually dissolve in blood serum. A sponge so treated and placed within the body, as in a deep wound, would be slowly dissolved with consequent release of the medicament. The dissolved carbohydrates would be absorbed by the body. Drug companies and medical workers are investigating the therapeutic value of starch sponges for use as absorbable dressings.

Soybean and Other Oilseed Crops Utilization Investigations:

The war has resulted in an unprecedented demand for vegetable oils both for food and for industrial use. To meet this demand, oilseed production has been greatly expanded. Although there are certain elemental differences in the oil and protein of the various oilseeds, these differences are not sufficient to prevent their interchangeability in many of the uses to which vegetable and animal oils, fats, and proteins are put. This interchangeability in use is facilitated in many instances by chemical or

processing modifications evolved through research. Oils are used for food, for lubricants, and in the manufacture of soap, paint, varnishes, linoleum, printer's ink, metal castings and plating, textiles, leather goods, glycerine, explosives, synthetic fibers, hydraulic fluids, molded products, rubber substitutes, etc. Proteins are used for fibers, paper coatings, water paints, foaming agents, adhesives, plastics, etc. In peacetime, their uses form an important part of our life, and in war many of them are grim necessities.

Of the oilseeds with which this Laboratory is concerned, namely, soybeans, flaxseed, sunflower seed, safflower seed, rapeseed, perilla seed, hempseed, and castor beans, only the first two are at present produced in the United States in quantities large enough to have major industrial significance. The others, or the oil therefrom, are imported for domestic consumption, as their production in the United States has not proved sufficiently profitable to reach substantial proportions.

While the war lasts, utilization studies on vegetable oilseeds are of vital importance in increasing production of old products to meet expanded requirements and in developing needed substitutes and new products. After the war, further utilization studies will be of importance in aiding the shift to a workable peacetime economy. In this shift, soybean oil must be given particular attention. Factory consumption has increased from 431 million in 1940 to 1,055 million pounds in 1943. This increased consumption has come in foods, and it was caused by an increased demand for food oils coincident with a reduced supply of other edible oils. When the other edible oils become available in increased amounts again, it is believed that the edible oil industry will reduce the amount of soybean oil used because it develops objectionable flavors and odors. Research to increase the use of soybean oil in drying oil industries and to prevent the formation of objectionable flavors and odors in edible products is being planned to meet the expected decrease in demand for soybean oil. In addition, the development of new and improved uses for other oils, for proteins and meal fractions from the oilseed is a proper function of this intensified research at the Laboratory. The following items are cited as typical examples in this field.

NORELAC - The development by the Northern Regional Research Laboratory of feasible methods for the production of Norelac, a thermoplastic resin which is obtained from soybean oil, and the establishment of a number of possible uses for this product has led to the semi-commercial production of Norelac. In 1943, an industrial organization became sufficiently interested in Norelac to build a pilot plant with a capacity of 1,000 pounds a week. This plant was placed in operation early in 1944, and approximately 15,000 to 20,000 pounds of the resin have been prepared. This production of Norelac will assure a thorough evaluation of the material by a large number of organizations for many possible uses to an extent which would not be possible at the Laboratory. Although the resin is not yet established as a commercial material, two of the major obstacles to its acceptance are surmounted; namely, laboratory and pilot plant development. Its future will

depend on production control of its properties, additional technical development for uses, and its cost in relation to competing products.

In addition to previous work on the use of Norelac as a protective coating for wood and steel and as a moistureproofing coating for paper, cellophane, glassine, and other webs, Norelac is being tested for coating tin cans for salt spray resistance. Preliminary experiments by the Quartermaster Corps have indicated that a Norelac lacquer has excellent resistance for this purpose, and additional commercial tests are now being carried on.

SOYBEAN ADHESIVES - As a result of research which was initiated to discover new adhesives from soybeans, the laboratory details of a new soybean-modified phenol-formaldehyde adhesive for plywood have been worked out. The glue is prepared by mixing the protein meal with a commercially available resin or with a freshly prepared resin in the "A" stage. One commercial trial has demonstrated that excellent birch and birch-basswood veneers can be fabricated with the glue.

A high protein meal is needed, and it can be obtained by removal of the water solubles from extracted soybean meal. Corn gluten (57 percent protein), which is obtained by centrifuging starch tailings, is a suitable replacement for the high protein soybean meal.

Soybean meal has been used for many years for plywood adhesives for soft woods, but in recent months, its use has declined. This decline appears to be due to an emphasis on the production of moistureproof and moisture-resistant plywoods. The older soybean adhesives were not moisture-resistant, while the new adhesive can be moistureproof or resistant by controlling the amounts of phenol-formaldehyde used.

Although the present demand for moistureproof plywood is very high because of the Navy's need for special types of Marine construction, the post-war demand for moisture-resistant plywood also is expected to be very great. In particular, the fabrication of plywood for outdoor construction where moisture resistance is necessary, such as barns, silos, cement frames, storage bins, and houses, will receive much attention by the industry. Since the new adhesive gives excellent moisture-resistant bonds with both soft and hard woods and its cost is estimated to be much lower than other waterproof adhesives, it is expected that the plywood industry will accept it as soon as sufficient plant trials demonstrate its feasibility.

SOYBEAN FLOUR - The use of alcoholic extraction of soybeans to improve the color and flavor of soybean flour and related products has been further developed during the past year, and a pilot plant for extraction of the oil and recovery of the byproducts has been designed. The contract for a portion of this pilot plant has been awarded, and studies on a pilot plant scale will be initiated as soon as installation is completed. Coincident with this research, uses for the improved flour are being investigated. The Bureau of Plant Industry, Soils, and Agricultural Engineering, at the Federal Soft Wheat Laboratory, Wooster, Ohio, is conducting baking studies. In addition, the value of the oil for edible purposes and the protein for

adhesives, fibers, and coatings will be or is being studied at the Northern Regional Research Laboratory.

SOYBEAN PROTEIN - Research on processing soybean meal for protein on a pilot plant scale has led to recommendations for the operating conditions and equipment necessary for obtaining proteins having desired characteristics. This information has been extremely valuable to industrial processors of agricultural products who intend to enter the soybean protein field, and it should eventually extend the industrial use of soybeans.

General Administrative Expenses

PROJECT STATEMENT

Project	1944	1945 (estimated)	1946 (estimated)
1. Central administration	\$92,244:	\$113,537:	\$120,640
2. Overtime costs	15,044:	18,963:	- -
Unobligated balance	13,622:	- -:	- -
Transferred to "Salaries and expenses, Office of Administrator, Agricultural Research Administration"	+27,895:	- -:	- -
Total estimate or appropriation :	148,805:	132,500:	120,640

This project provides for the administrative supervision and direction of the work of the four regional research laboratories. Its objects are (a) to develop a well-coordinated research program for the laboratories, (b) to maintain proper control in order to avoid duplication of research activities, and (c) to maintain in Washington centralized control and direction of the business activities necessary for the proper functioning of the organization as a whole. The coordination and scrutiny of the activities of the four Regional Research Laboratories has been continued with a view to having the research program offer the greatest possible service to the war effort.

Frequent conferences have been held with the Directors of the laboratories in order to maintain a well-coordinated, forward-looking research program. For the latter purpose, meetings of the Agricultural Experiment Station Relations Committee have been held at each laboratory, and necessary contacts have been maintained with the Office of the Agricultural Research Administrator and other agencies.

(f) Synthetic Liquid Fuels (Transfer to Agriculture)
(Allotment to Bureau of Agricultural and Industrial Chemistry)

This budget schedule covers obligations during 1945 and 1946 under an allotment from the Department of Interior for the construction and operation of semiworks plant for studies of production of liquid motor fuels from agricultural products.

(g) Special Research Fund, Department of Agriculture
(Allotment to Bureau of Agricultural and Industrial Chemistry)

This budget schedule covers obligations under an allotment for special agricultural chemical researches of a fundamental nature.

(h) Emergency Rubber Project, Department of Agriculture
(Allotment to Bureau of Agricultural and Industrial Chemistry)

This budget schedule covers obligations under an allotment for investigations to develop new or improved processing methods for the manufacture of rubber from domestic rubber-bearing plants, including guayule, cryptostegia, and in the fiscal year 1944, kok-saghyz (Russian dandelion), and goldenrod.

(i) Working Funds (Bureau of Agricultural and Industrial Chemistry)

This budget schedule covers obligations during 1944 and 1945 under advances, pursuant to Section 601 of the Economy Act of June 30, 1932, for services performed for various agencies as shown in the following statement of obligations under supplemental funds.

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS *
(1944 and 1945 figures include overtime costs)

Item	Obligations, 1944	Estimated obligations, 1945	Estimated obligations, 1946
<u>Synthetic Liquid Fuels (Transfer to Agriculture):</u> Construction and operation of semiworks plant for studies of production of liquid motor fuels from agricultural products	- -	\$178,162:	\$101,620
<u>Special Research Fund, Department of Agriculture:</u> Special research projects (agricultural chemical researches)	\$57,473:	75,272:	66,623
<u>Emergency Rubber Project, Department of Agriculture:</u>			
Pilot-laboratory investigations on guayule	24,552:	- -:	- -
Pilot-laboratory investigations on cryptostegia	24,471:	25,000:	- -
Pilot-plant investigations on kok-saghyz	196,424:	- -:	- -
Pilot-laboratory investigations on goldenrod	89,997:	- -:	- -
Pilot-plant investigations on guayule	69,033:	100,000:	63,595
Total, Emergency Rubber Project	404,477:	125,000:	63,595
<u>Working Fund, (Bureau of Agricultural and Industrial Chemistry):</u> Advances from: Foreign Economic Administration:			
Investigations of the quality of citrus fruits for Vitamin C Content, and determination if production methods and equipment of Brazil conform to United States specifications:	1,607:	- -:	- -

* Exclusive of Lend-Lease funds which are not included in the regular Budget

Item	Obligations, 1944	Estimated obligations, 1945	Estimated obligations, 1946
<u>War Production Board:</u>			
Supervising commercial tests of the Balls-Tucker process for the manufacture of alcohol at certain industrial plants	1,114:	- -:	- -
Investigations in food com- pression and packaging of dehydrated compressed food products	17,641:	3,295:	- -
Total, War Production Board:	18,755:	3,295:	- -
<u>Office of Scientific Research and Development:</u>			
Studies on the synthesis of penicillin	32,376:	- -:	- -
Total, Working Funds ..	52,738:	3,295:	- -
TOTAL, OBLIGATIONS UNDER SUPPLEMEN- TAL FUNDS	514,688:	381,729:	231,838

PASSENGER-CARRYING VEHICLES

The estimates provide \$2,250 for the replacement of three passenger-carrying vehicles for use by members of the scientific staff of the Regional Research Laboratories for field surveys, inspection trips, collection of official samples, etc.

Automobile transportation is practically indispensable for the proper conduct of the work at the Regional Research Laboratories, since the area served by each laboratory ranges from nine to sixteen states, where in many instances experimental work must be conducted at points situated in remote areas where public transportation facilities are very limited and in many cases not at all available.

The three cars to be replaced were purchased in the Spring of 1939. By the end of the fiscal year 1945 they will have been in use in excess of six years and will have an average of 50,000 miles. Experience has shown that it is not economical to operate a vehicle beyond this mileage because of its inefficient use of fuel and oil, and mounting repair costs. Due to wartime conditions it is very difficult to obtain necessary repair parts and adequate service to maintain the cars in good condition and the rate of depreciation is therefore much more rapid than at normal times.

The present use of these cars is restricted to emergencies and official trips to nearby points not served by common carrier.

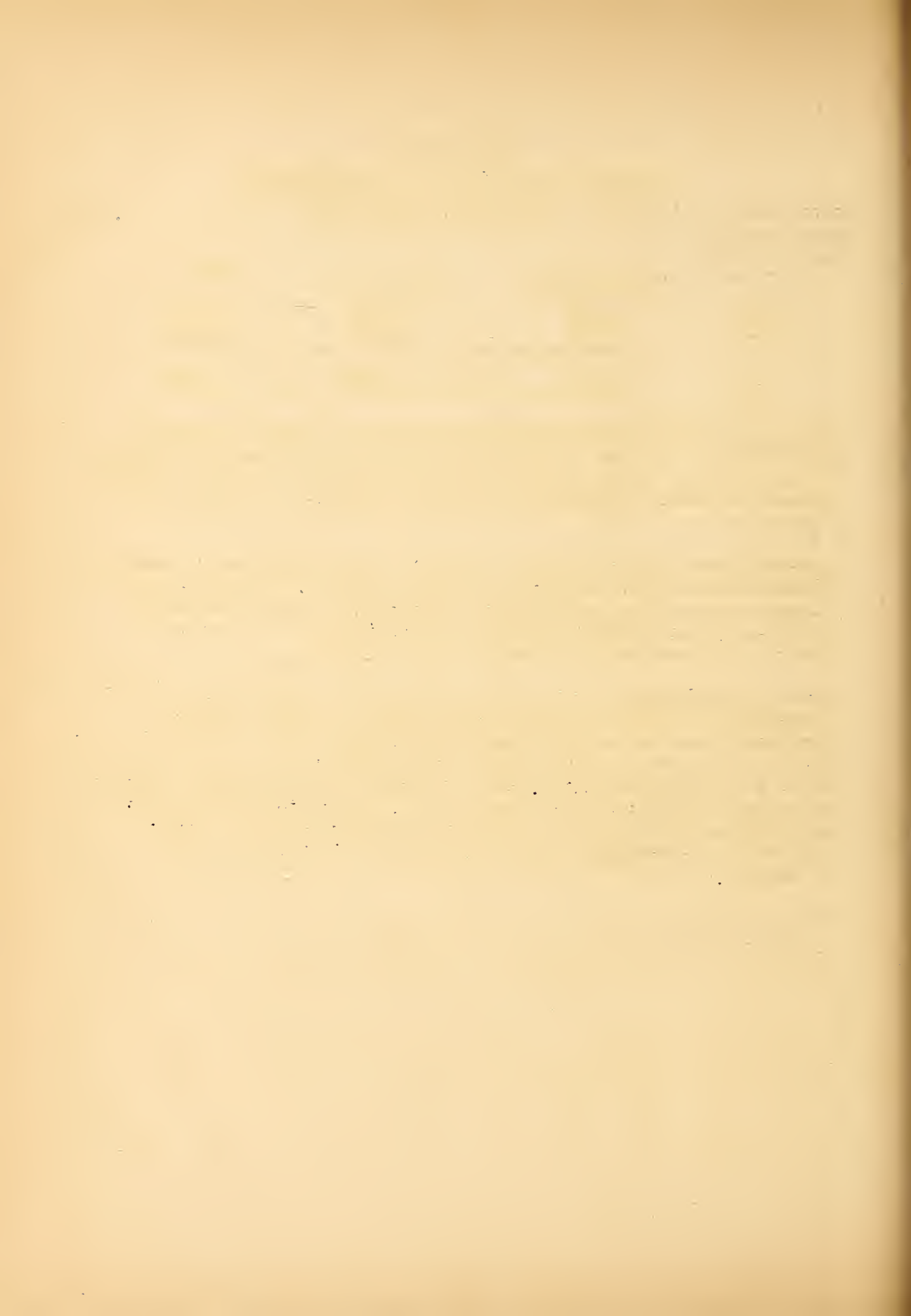
PENALTY MAIL
Section 2, Public Law 364, 78th Congress
(Allotment to Bureau of Agricultural and
Industrial Chemistry)

	<u>Category 1</u>	<u>Category 2</u>	<u>Total</u>
1945	\$800	\$2,099	\$2,899
1946	1,027	2,662	3,689
Change	+227	+563	+790

Category 1 consists of technical bulletins and other publications on the work of the Bureau furnished as a result of specific requests for information and as an aid in answering inquiries on agricultural chemical research, including industrial utilization of agricultural products.

Category 2 consists of general operational and administrative correspondence between the Washington and field offices of the Bureau including the four Regional Research Laboratories, other government agencies, and with private concerns and individuals in connection with the programs being carried on by the Bureau.

The increase of \$790 for 1946 is based on (a) an increase of \$270,288 carried in the Budget for additional research in 1946, of which \$253,254 is for the Regional Research Laboratories, and (b) the fact that as the research of these Laboratories develops to a greater level of reported results, there is an increase in the amount to be expended in furnishing this information in the form of publications to the interested public, as well as an increase in the volume of operational and administrative correspondence incident to these projects.



BUREAU OF HUMAN NUTRITION AND HOME ECONOMICS

(a) Salaries and Expenses

Appropriation Act, 1945	\$806,630
Budget estimate, 1946	<u>850,000</u>
Change for 1946:	
Overtime decrease -84,280	
Increase <u>+127,650</u>	<u>+43,370</u>

PROJECT STATEMENT

Project	1944	1945 (estimated)	1946 (estimated)	Increase or decrease
1. Foods and nutrition investigations	\$167,580	\$283,473	\$283,473	- -
2. Family economics investigations	108,891	189,420	264,420	+\$75,000 (1)
3. Textiles and clothing investigations	98,179	148,266	148,266	- -
4. Housing and household equipment investigations	37,045	50,537	103,187	+52,650 (2)
5. Home economics information	30,472	50,654	50,654	- -
6. Overtime costs	62,217	84,280	- -	-84,280
Unobligated balance	7,336	- -	- -	- -
Total available	<u>511,720</u>	<u>806,630</u>	<u>850,000</u>	<u>+43,370</u>
Transferred to "Salaries and expenses, Office of Information, Department of Agriculture"	+700	- -	- -	
Total estimate or appropriation	<u>512,420</u>	<u>806,630</u>	<u>850,000</u>	

INCREASES OR DECREASES

The net increase of \$43,370 for 1946 consists of the \$84,280 decrease for overtime, and the following:

- (1) An increase of \$75,000 under the project "Family economics investigations" to study consumption levels of farm families and their adjustments to different incomes:

Objective: To provide information needed regarding problems that rural homemakers face, the kind of living rural families get under different circumstances, and the ways in which they adjust their expenditures for living to income changes.

The Problem and Its Significance: Because they are concerned with helping families get greater satisfactions from their expenditures of time and money and their use of materials, home economists need information that shows the kind of living that rural families now get under the different income and price situations commonly found. This should include facts regarding the amounts spent for living by rural families, the kinds and quantities of goods and services bought, and the kind and amount of goods produced at home for family use. Such facts are also needed as a basis for comparing the levels of living of families on farms with those in urban communities, and will be important in comparing farm with nonfarm groups as to their ability to buy farm and industrial products and services in the postwar period.

Certain information on the expense and quality of rural family living in 1935-36 and 1941-42 is available but facts are needed on incomes, purchasing power, and demand for goods on the market at this time.

Plan of Work: The study will be planned and carried on in cooperation with the Bureau of Agricultural Economics, State Experiment Stations, and other research agencies. Information will be obtained by means of interviews from a small sample of families carefully selected to represent farm and rural families in various geographic regions, and to yield reliable national averages for the rural population.

- (2) An increase of \$52,650 under the project "Housing and household equipment investigations" to develop basic information on functional requirements of farm and rural dwellings:

Objective: To develop information and to sketch plans of dwellings that take into account functional requirements of rural living so that these requirements may be incorporated in house plans designed specifically to meet farm and rural home needs.

The Problem: Functional requirements of city dwellings have been given some consideration in the development of public housing and private homes; rural dwellings for the most part have been constructed from ready-made house plans or from plans drawn by local builders. Few ready-made plans or local builders take adequate account of the fact

that rural houses must be efficient workshops for extensive home-production activities, and that rural homes have special needs as to number of rooms, size, use, and arrangement; and arrangement of equipment. It is important to determine the functional requirements of farm and rural homes in different regions of the United States and the ways in which they may be met in construction plans.

Significance: Housing represents a large investment of public and private funds and for most rural families means a lifetime commitment. Probably thousands of rural homes will be built or remodeled after the war. Information should be available to avoid common errors made in house construction and to make possible increased efficiency for housework and more comfortable facilities for family living. The facts developed should be translated into terms that may be used in planning satisfactory houses. The relation of the house to the farm plant and the farm business in the different regions of the country must also be considered.

Plan of Work: Surveys initiated in the fiscal year 1945 in cooperation with State research agencies to provide information on a regional basis as to housing needs and preferences of rural homemakers, will be continued until facts have been collected from all regions.

The proposed increase will provide for an evaluation of the results of these surveys, region by region. Consideration will be given to the type and cost of housing that farms differing in productivity can support, and to the usefulness of the house as a workshop and place to live. Laboratory study will be made of the efficiency and comfort of various arrangements of rooms differing in size and shape, such as are found in various types of houses, and of various placements of equipment and furniture within rooms.

Based on this research, sketches of house plans will be prepared to meet housing needs of different economic groups in different parts of the country. Assistance will be given to agencies with responsibilities for housing in rural areas so that houses built can serve as demonstrations of, and practical laboratories for testing, the adequacy and suitability of house plans for satisfactory family living and efficient home production. After houses built or remodeled from the regional plans have been lived in for some time, families will be interviewed to determine the relative success of each plan. This may bring out the need for adjustments in plans.

The work described above will be conducted in close cooperation with the Bureau of Plant Industry, Soils, and Agricultural Engineering; the Bureau of Agricultural Economics; the Forest Service; the Federal Public Housing Authority; and home economists, agricultural engineers, and others in State Experiment Stations.

WORK UNDER THIS APPROPRIATION

Objective: To determine the kinds and amounts of food, clothing, and other goods and services required in the home for healthful living; to develop methods of using these more efficiently and effectively; and to ascertain facts needed to advise on procedures, programs and policies that would assist families to improve their living levels.

The Problem and Its Significance: The home has a many-sided responsibility in safeguarding the health and developing the morale of the family. These ends may be furthered or weakened by the kind of living the family manages to get for its expenditure of money, work, and time. Decisions regarding the use of family resources are particularly difficult now because of shortages of goods and help. Adjustments to such changes in the economic situation can be eased through re-evaluation of standards of living. This in turn requires all possible knowledge of the relative economy, usefulness, and importance to living of the various types of goods and services to which we may have become accustomed or among which we may choose.

General Plan: In the fields of food and nutrition, textiles and clothing, and household equipment, laboratory studies are being made to develop information which will help the homemaker in selecting food, clothing and other goods best suited to the purpose, and to assist the family in using these efficiently. Field studies are made to ascertain the kind of living had by various groups of the population and the effect of changes in income, prices and supply upon family living.

Examples of Progress and Current Program: The following examples of recent accomplishments under this appropriation are cited by fields of work to show progress on some aspects of the broader problems confronted.

Foods and nutrition investigations: Wartime demands on our food supply have made it essential to look carefully at what is known about nutritional requirements of people and the nutritive value of the foods which might be drawn upon to supply human needs. Current laboratory research in the Bureau relates chiefly to the value of foods as sources of nutrients and how best to conserve food through home food preservation and cooking; the extent to which one food can be used as an alternate for or a supplement to others; and ways to use different foods advantageously in wartime meals.

Light on the protein problem: World needs for protein, stuff of which body tissues are built, continues to be a major issue in war and postwar plans for food supply. This country is liberally supplied with protein food, as compared with other countries. Moreover, much of our supply comes from meat, milk, eggs, and other foods rated high as sources of "efficient" protein, meaning proteins that resemble those of the human body and therefore are capable of being used advantageously for growth and repair. A little of this efficient protein also goes a long way in

supplementing the proteins of cereals and plants, some of which because of their chemical make-up -- their amino-acid content -- are not adapted to serve as sole sources of protein for human food.

Although there are hundreds of proteins in various foods, all these are reduced during the digestive process to fewer than two dozen amino acids, eight of which have been shown to be essential to the nutrition of the young adult. Ultimately the protein problem is a problem of finding what amino acids are furnished by everyday foods, and how these can best be combined to satisfy the body's needs. Also, though needs for protein are known in general terms, the amounts of various amino acids required at different stages of body development are still unknown. Not until such knowledge is fully available, shall we be able to answer with certainty the many practical and scientific questions posed whenever supplies of protein-rich foods become restricted.

The Bureau is working on these problems from both the long-range and immediate view. One contribution in this field during this past year marks a milestone in the science of nutrition. A new method has been developed for determining certain amino acids directly in foods. This makes possible much more rapid advance in supplying precise information on the protein value of our common foods. An interesting by-product of this fundamental research was the finding that potatoes contain unusual amounts of two amino acids, tyrosine and tryptophane, not in the protein molecule, but in a free state in the juice of potatoes.

More directly related to the war program are studies completed this year on the relative value of the proteins of soybeans, peanuts, and cottonseed. These show conclusively that these plant proteins have high nutritive value and can serve to "extend" or "spare" the proteins of meat, milk, and eggs when circumstances require.

Further tests showed that cooking in the presence of moisture for moderate time (15 to 30 minutes) increases the nutritional value of the proteins in soya flour and grits; whereas overcooking deteriorates both protein and thiamine (vitamin B₁) values. During the past 18 months, 130 recipes for the use of soya flour and grits in home and school-lunch cooking were developed in the Bureau's laboratories and given nationwide distribution.

Preliminary work was done on a similar group of recipes using peanut flour, looking toward the time when this product may become another high-protein low-cost food widely available on the retail market.

Home canning: In 1943 home canning was again the most widely used method of home food preservation. An estimated 25 million families canned for their own use over four billion containers of food. Spoilage,

however, took an undue toll of this home-canned food. One midwestern State, for example, estimated that by December '43, over two million quarts of home-canned food had spoiled in that State alone. While some of this spoilage was traceable to defective equipment or to the home canner's failure to follow directions accurately, much of it pointed to the urgent need for additional controlled experimentation on which to base improved home-canning practices.

Recognizing that 1944 would again be a year of extensive home canning, the Bureau revised and reissued its home canning bulletin, this time presenting step-by-step sequences for a typical fruit and vegetable, in pictorial form. Many of the procedures recommended are adaptations of commercial practices, since industry has long been the chief source of scientific data on canning methods. But because equipment for commercial canning differs greatly from that used in the home, wide margins of safety had to be allowed, in adapting commercial practice to the home situation.

Now, with the increased support for research in home food preservation, provided in the 1944 and 1945 acts, this Bureau has developed plans for acquiring the information needed to put home canning practices on a thoroughly scientific basis.

One group of studies on home canning has to do with establishing correct processing procedures. These are concerned with the rate at which different foods heat through when processed in a steam pressure canner or in a boiling water bath. The rate, of course, varies with type of food; method of preparation, density of pack, and size, shape, and material of container, and these too will be studied.

Work also is being done to learn more about the nature of the spoilage organisms causing difficulties in home canning. Other lines of study will be the operating efficiency of different kinds of steam pressure canners and the accuracy of gauges and thermometers.

In consequence of our work during the fiscal year 1944, the time and temperature for the canning of meats in quart glass containers are being changed from 120 minutes at 250° F. to 100 minutes at 240° F. This shorter processing period at a lower temperature will do much to ensure a more palatable product of superior nutritive value. Exploratory work has also been carried out looking toward revising or verifying present methods of canning tomatoes and spinach.

Throughout all the studies the aim is to reduce the incidence of spoilage in home-canned food and yield safe products retaining food quality and nutritive value to the highest possible degree.

Home freezing of food: Polls of rural and urban families indicate that quick freezing is the method of home food preservation most likely to expand after the war. Unquestionably, as soon as factories can be reconverted to supply the necessary equipment, the public will be offered many types of freezer cabinets and greatly increased facilities at community freezer-locker plants. Commercial food-freezing companies are also planning new methods of merchandizing frozen foods, calling for new-type storage facilities in the home refrigerator.

These developments in commercial and home freezing of foods pose new problems from the home standpoint if this method of preserving food is to yield products high in eating quality and nutritive value. Many questions are also pending as to the best treatment of food before freezing. For example, while preliminary tests conducted by the Bureau this past year with vegetables confirm that steam blanching may be preferable to water blanching as a pretreatment, temperature studies show that equipment now found in homes is not well adapted to efficient steam blanching. Work is therefore under way to design simple steam-blanching equipment for this purpose.

Other related problems on home freezing will be attacked in the Bureau's laboratories and in cooperation with State agencies. These studies will seek answers to such basic questions as how great and how frequent can be the fluctuations in temperature in home freezer-storage cabinets without deterioration in the quality of the frozen food during long periods of storage. Similarly important in short-period storage is the question of how high can the holding temperature in the household refrigerator be without affecting adversely the quality of the frozen food. Naturally, the lower the temperature required in the storage compartment, the greater the cost of producing and operating this piece of home equipment. These data are therefore of economic importance to the manufacturer as well as to the purchaser of postwar home refrigerators.

New forms of food: The need of the armed services for compact, nutritious food, resistant to adverse storage conditions over long periods, is obvious. Studies leading to the development or improvement of possible new forms of food have been carried out cooperatively with other research groups -- the Bureau of Animal Industry; the Bureau of Plant Industry, Soils, and Agricultural Engineering; and the Bureau of Agricultural and Industrial Chemistry. The contribution of the Bureau of Human Nutrition and Home Economics has been to measure the effect on palatability and nutritive value of different methods of processing and packaging, and of different storage conditions. These studies have related largely to dehydrated beef, pork, eggs, soup mixes, and vegetables. Some work has also been done to find the methods of preparation that will make these products appetizing.

Efforts have also been directed toward correlating over-all consumer acceptability scores, as well as special judgments regarding flavor, texture, and other factors in palatability with the more objective chemical or physical tests that can be made by laboratory methods.

Wartime recipes to match food supplies: How to adjust customary cooking methods to changing food supplies, is a major problem with the wartime cook. To help her make the most of temporary abundances as well as scarcer rationed foods, the Bureau maintains a wartime food preparation service. As fast as tested, recipes and suggestions for wise food use are channeled to the public in printed leaflets for distribution through nutrition committees and other field agencies, and by radio and press release.

Noteworthy examples of this service during the last year are two series of recipes on potatoes and eggs, totaling 70 in all. These have two-way use. In times of abundant supply they show how to serve these familiar foods in a variety of ways to avoid monotony. When supplies are short, by demonstrating how to conserve nutritive value, they help a family to get full good from the limited quantity available.

Diets to promote growth, health, and well-being: In order to plan both family and large-scale programs for the production and use of food, we need to know more about the nutritive quality of different types of food and how best to combine them into diets that will promote normal growth, health, and general well-being. For example, in time of war or economic pressure, we may have to eat less of the relatively expensive foods of animal origin and correspondingly more of plant foods. Just how far we can go in that direction without impairing nutritional well-being is the question. To answer this, studies are under way on diets made up largely of cereals combined with small amounts of green leafy

and root vegetables and varying amounts of meat, milk, or eggs. This work is largely carried on under allotments from the Special Research Fund.

Also under emergency circumstances we are more dependent on vegetables for our supply of vitamin A. Another study is therefore directed to finding the extent to which carotene from certain vegetables, such as sweetpotatoes and kale, can be converted into vitamin A by the body. Experimental work on carrots is nearing completion.

A third line of research closely allied to this problem has to do with conserving maximum amounts of nutritive value in food during preparation for the table. Studies are under way to answer such practical points as whether to use soda in the cooking of green vegetables, and what is the effect on food value of the straining and pureeing of vegetables for infants and invalids.

Family economics investigations: Essential to war or peacetime programs looking to the improvement of the home is continuous study of how economic and other forces affect American family life.

Appraising levels of food consumption: The interrelationship between adequate food, good health, and working capacity stands out more clearly than ever, as the war goes on. Consequently, studies are being made at frequent intervals to follow the trend in nutritive value of the over-all food supply of our civilian population, as a cooperative project with the Bureau of Agricultural Economics and the War Food Administration.

Starting from estimates of the quantities of various foods available per capita for human consumption, the nutrition experts of this Bureau translate these quantities -- pounds of flour and bread, for example -- into calories, grams of protein, fat, carbohydrate, and on through the essential minerals and vitamins. Then adding together the nutrients from flour and bread to those from milk, meat, potatoes, and all our common foods, they arrive at an average figure for the total number of calories and other nutrients available to civilians at the retail store stage in the distribution chain. Many people consume less, many more than average, it is recognized. Also, though the resulting figures have been corrected to allow for inedible refuse, such as orange skins, vegetable parings, and meat bones, they do not take into account food wasted by careless handling and cooking in the home kitchen. Further research is needed before this can be done. Nevertheless, our figures are an invaluable index to show the direction which our food supply is taking from the nutritive value standpoint.

For 1943, these studies show, our civilian food supply provided more of every nutrient per capita than in 1935-39. For most nutrients the 1943 situation was even better than 1941, though in this last prewar year food production was at a high level, there was no rationing, and our armed services and Lend-Lease food needs were relatively small. Preliminary estimates for 1944 indicate no reduction from 1943 in over-all nutritive value.

Much of our recent improvement in dietary levels can be traced to increased consumption of milk, citrus fruits, and green and yellow vegetables. Victory gardens have helped to supply vitamins A and C and enrichment of white flour and white bread has improved our dietary supply of several nutrients, notably thiamine.

It should be emphasized again, however, that although average quantities of most nutrients in the per capita civilian food supply in recent years appear to meet or exceed recommended dietary allowances, many persons fail to get adequate diets. This is due to low incomes, lack of knowledge about nutrition, and indifference about food. Our latest information as to the way in which our national food supply is divided among families in various economic groups dates back to the spring of 1942. A study made then indicated that many families had diets that were low in certain essentials, especially calcium and riboflavin, as compared with the dietary recommendations of the National Research Council. Such studies are needed at intervals.

Guiding food consumption: No small share of the success of maintaining nutritional levels during wartime is due to the practical interpretation of research findings about nutritional requirements and food values into concrete suggestions that homemakers and their families can practice. Nutritional requirements in terms of calories, protein, minerals, and vitamins, can, of course, be translated into many lists of food combinations. During the year 1943-44 edition of the Bureau's food plans to help families provide good nutrition at moderate or at low cost has come from the press, revised to take account of rationing and wartime food supplies.

Guiding food production: The Bureau's nutrition experts have helped define what are the nutritional needs of civilians and have counselled with those responsible for the Nation's food production program as to how civilian needs can be met by common everyday foods economical to produce and market.

The Bureau's compilation of data on nutritive value of food is being used in studying the nutritional returns received from the application of labor, land, and other resources to the production of important crops and livestock products in this country. The results of studies, made in cooperation with the Department's economists, show in quantitative terms what has generally been recognized — that animal products are relatively more expensive forms of food than many of the food crops, particularly if the feed is composed to any large extent of products that can serve directly as human food.

Compared with animals that can yield food only upon slaughter, the cow, providing milk as well as meat, has long been known to be an economical converter of feed into calories and protein. Milk is also an outstanding source of calcium and riboflavin, nutritive factors often relatively low in American diets. Nutritionists have, therefore, not only urged families

to consume more milk but have also advised increased milk production and the use of an increasing proportion of what is produced for human consumption. Partly as a result of these efforts, the civilian demand for milk has stepped up considerably in recent years, and per capita consumption of milk and milk products (other than butter) is now almost 20 percent higher than it was in the 1935-39 period.

Among food crops, too, there are differences in the yield per acre or per unit of labor of calories, protein, minerals, and vitamins. Studies have been made, for example, of the relative economy, nutritionwise, in the production of different vegetables and fruits. As a result, recommendations have been made to truck farmers to grow more of some and less of others -- for example, more carrots, cabbage, beans, tomatoes, and onions, and less celery, cucumbers, and watermelons. Victory gardeners likewise have been urged to grow crops that, for the space occupied, give the greatest returns in terms of minerals and vitamins -- crops like tomatoes, carrots, beans, and green leafy vegetables. The basic information is being furnished to the Bureau of Agricultural Economics, the food and agricultural organization, and other groups interested in making the best nutritional use of food resources.

Health and the family budget: The war has brought inescapable proof of our need for better medical care. For rural families the need is particularly great, and postwar plans for improvement in the quality and distribution of rural health facilities are under discussion throughout the country.

The Bureau's studies of rural family living are contributing facts about expenditures for medical care, and the differences between rural and urban families in this respect. They show that farm families spend about as much for medical care as city families when money incomes are the same. Most farm families, however, have lower incomes than city families -- in 1941, the median net cash income of farm families was less than half that of urban families.

Doctors, nurses and hospital facilities are frequently less available to rural than to urban families. Some kinds of hospitals and clinics are expensive to maintain and so are found chiefly in cities, where there is a greater concentration of wealth and population. Doctors trained in highly specialized fields cannot make a living in the country; they are needed in the treatment of only a small percentage of illnesses or disabilities and must, therefore, be able to draw patients from a large population. Although most farms are not so far from a village or small town as from a city, even this distance imposes a handicap to the farm family. The necessity of a special trip to town to see the doctor or mileage fees if the doctor is called to the farm, makes the farm family more reluctant to use his service.

Another outstanding difference in the practice of rural and urban families in securing medical care, disclosed by this study, is their use of prepayment plans for medical care. In farm communities membership in prepayment plans has been confined almost exclusively to families in the lowest income groups. In urban areas on the other hand, the proportion

of families with membership in prepayment plans is small among low-income groups; most of the subscribers are in moderate or comfortable circumstances.

In its formulation of rural family budgets for the study of real income on the farm as compared with urban communities, the Bureau is estimating as one item of the budget the cost of adequate medical care in a rural community. This is being done in cooperation with the U. S. Public Health Service and other health agencies.

What is the American standard of living: There is much discussion now of protecting the American standard of living against lower foreign standards in the postwar world. But what is our standard? Planners and research workers turn to home economists to tell them what it means in actual kinds and quantities of food, clothing, housing and other physical needs.

As part of its continuing function of formulating budget plans for various population groups, the Bureau has contributed to the setting up of minimum physical standards for the operation of war relocation camps, and this past year published a guide to the preparation of minimum wage budgets for women. Done at the request and with the cooperation of the U. S. Department of Labor, this publication provides State wage boards with an itemized list of the goods and services a wage-earning woman must have for healthful living, together with suggestions for pricing these. The Bureau's leadership is being sought in the preparation of such material because of knowledge of requirements based on laboratory research in food and clothing and nation-wide studies of consumption habits. State wage boards report that by having this scientifically compiled list of items priced locally, they thus arrive at a cost-of-living figure free from personal bias and the heat of debate. This they find of invaluable help when setting the standard minimum wage for women required by the State law.

To help define the needs and wants of rural families, Bureau specialists are studying statistical data collected from rural families and other available information on levels and standards of American living. A minimum adequate clothing budget for farm families and a description of a minimum adequate farm house are being developed. A special study of rural family needs and preferences in housing and household equipment is being undertaken to yield information needed in developing plans for building or remodeling homes after the war.

Textiles and clothing investigations: During the past year, serious shortages of many essential items of civilian clothing became apparent. Due to continuing needs of the armed forces for great quantities and varieties of clothing and textile articles, materials and manpower for the production of civilian goods have been limited. Deterioration in fabric quality and scarcity of articles in the lower price ranges have brought serious problems to homemakers. The following examples show how the Bureau has directed its research facilities to help solve these. Though our prime concern is the home front, several research projects were directed to furnishing material needed by the military forces.

Helping homemakers to meet the clothing shortage: One way the homemaker can meet the present situation, at least in some measure, is through remodeling and repairing articles that would not seem worth the effort in days when they could be readily replaced.

To help women develop professional skill for these jobs, Bureau experts have prepared manual-type publications on making a standard-type dress at home, cleaning and adjusting sewing machines, mending carpets and rugs, as well as all types of clothing fabrics, and making overcoats, suits, dresses, and even knitted garments and underwear. Traveling exhibits of remodeled clothing supplement the printed material in a number of cases. Extension workers report that this material has helped in returning to use thousands of articles that would otherwise have been wasted and to that extent relieved buying pressure on new goods in the stores.

Not only is there a shortage in certain lines of merchandise, but there is serious quality deterioration in civilian textile goods, constituting enormous hidden price rises. Inasmuch as these trends seriously affect the economic well-being of the family, the Bureau, in cooperation with home economics research agencies in the States is initiating a study of the qualities of clothing and fabrics available to consumers in various communities. Minimum requirements in fabric and clothing construction will be developed through extensive tests.

Functional clothing: Wartime necessity has greatly accelerated the demand for functional clothing, not merely for wear at work, but for dress and street use. Although some of the present vogue may pass with the war, there are certain basic types of garments that can be greatly improved in comfort, convenience, and economy of making and laundering, by applying the principles of functional design.

Bureau clothing specialists accomplished this with seventeen original designs for women's work garments for use in field and factory. These have been widely reproduced in both patterns and ready-to-wear garments. This past year fourteen designs for dresses and aprons for wear in the home have been completed, and are now being released to the public through Government and trade channels. Attention will be turned next to designing functional garments for infants and children.

That a more rational approach, based on scientific data, is needed for the sizing of clothing is widely recognized by industry as well as by the almost universal experience of men and women who attempt to buy clothes to fit the body. Shoes probably cause most trouble and most deeply affect health. Millions of American men and women are limping their way through life on feet deformed by ill-fitting shoes.

Before the shoe-sizing situation can be improved, representative groups of American feet must be measured and these data used in building modern lasts for shoe manufacture. Industry recognizes this need, and is giving informal cooperation to work initiated by this Bureau, particularly through help on selecting the foot contours to be measured and designing the anthropometric instruments to be used.

For some time the method for measuring the contours of the human foot presented a difficult technological problem. This has now been solved on a laboratory scale, as well as a method of transferring these data to paper where they can be subjected to statistical analysis. A pilot scale study is now being made with groups of soldiers at one of the Army's reconditioning camps.

Cotton hosiery studies redirected: Five years ago, the Bureau began a study of hose design and a series of laboratory and service tests on women's cotton hosiery, and since that date has issued 44 progress reports and technical publications on this hosiery study.

Two accomplishments proved of timely value in the wartime clothing situation. In the first place, by reason of this research the Bureau was able to make available to the trade, when the silk crisis came, over 200 designs for women's full-fashioned cotton hose. These included sheer, medium, and heavy weights in plain and fancy weave for street, work, and dress wear. Some of these designs were reproduced exactly and placed on the market. All unquestionably furnished manufacturers with ideas for developing their own exclusive designs.

Another part of the cotton hosiery study yielded information on yarns, finishes, and hosiery construction at a time when especially needed. These studies have served to show how some of the newer varieties of American-grown cotton and the medium staple lengths can be used acceptably in hosiery manufacture. By actual service studies wearing qualities were determined of hose made of different varieties of cotton and with different yarn and fabric constructions.

For example, experiments were made on American-Egyptian cottons grown at the U. S. Experiment Station at Sacaton, Arizona, and a commercially produced Coker Wilds cotton. Both were spun under controlled conditions into 90/2 and 120/2 combed yarns, knitted into women's full-fashioned hose, and the hose worn by student nurses in a Washington hospital. The serviceability of the hose was studied by physical and chemical analyses of samples removed at regular intervals. The three American-Egyptian cottons produced stronger yarns and hose with greater resistance to bursting (bursting strength) than did the shorter staple Coker Wilds cotton, although there was no significant difference in length of service given by the hose.

For the first time data were reported on the wear that can be expected from various constructions of cotton hose. This included comparisons of the wearing qualities of hose with different kinds of toe reinforcements -- a matter of utmost importance in the construction of durable hose. Studies also showed that increasing the course count from 38 to 42 and 46 and increasing the gauge from 42 to 45 produced significant increases in the bursting strength of new hose.

In studies looking to methods of increasing the usefulness of yarns of medium staple length for hose, approximately 125 chemical treatments (each varying in composition and concentration of ingredients) were

applied experimentally to yarns, and the effect measured by appearance ratings and by breaking strength and weight determinations. From the results of these experiments the most effective treatments (20 in number) were selected for further study. These have been tested on yarns of different counts and on trial swatches knit from these treated yarns. The appearance of the yarn was improved and breaking strength of some of the yarns so treated was increased in some instances by as much as 50 percent.

Contributions have also been made to our knowledge of the laboratory testing of hose. For example, a report comparing two abrasion machines now coming into use for testing the resistance of hose to rubbing was published for the use of laboratory technicians.

The Bureau's studies relating to cotton hose have shown cotton growers and hosiery manufacturers the possibilities of American-grown cotton in high-grade hosiery manufacture. And it has contributed important methodology to the scientific study of a standard article of clothing. The emphasis in this project is now being shifted to include studies of other types of knitwear. Efforts are being made to determine the relative merits of natural and mercerized cotton and synthetic fibers for knit materials, as measured by warmth, durability, and other physical properties - as well as by their effect on comfort and on the physiological reactions of the human body.

Aids to microbe control on the military front: Two series of investigations, undertaken at the request of the armed services, are yielding promising results for the better control of disease-spreading organisms in clothing. The objective of one series was to find a fungicide which, when added to the dubbing used in shoe dressing, would prevent reinfection with athlete's foot and keep shoes from mildewing, without, at the same time, producing toxic effects on the wearer of the shoes or harming the leather itself. Of the large number of fungicidal chemicals tested for this purpose in our laboratories, several have been found to have good inhibiting action against the harmful fungi. Results remain, however, to be further checked by storage experiments. The National Bureau of Standards is cooperating in this project by furnishing leather and dubbing, as well as making available equipment for physical tests on the leather.

As with shoes, great quantities of wool equipment have had to be discarded because methods of freeing it from dangerous micro-organisms have ruined its usefulness. How to sterilize wool in such a way as not to render the cloth harsh and boardy and the fibers weak, is a problem of tremendous economic importance to the armed forces. Previous research on wool sterilization by this Bureau afforded a good foundation for attack on this problem. Methods developed by the Bureau succeeded in sterilizing wool fabrics, leaving them soft and pliable and with loss in breaking strength of less than one-sixth. In contrast, other commonly used sterilizing processes leave the fabrics harsh and stiff and with losses in breaking strength sometimes of more than one-third.

Closely allied to this work on ridding fabrics of bacteria injurious to health, is the research on treatments of fabrics to make them resistant to mildew and insect damage. To be practical such treatments must also hold despite sun and rain. Bureau studies had revealed that certain natural dyes and some chemical compounds such as copper naphthenate and copper sulphate combined with 8-hydroxy quinoline are especially valuable for rendering outdoor fabrics mildew resistant. In cooperation with the Bureau of Entomology and Plant Quarantine some of these same treatments applied to fabrics were subjected to attack by termites. Five of the sixteen treatments that were so tried were found to be resistant to the insects.

Cooperative fur studies: To meet the needs of the War Department for facts on the properties of fur for use in clothing and bedding by troops in Arctic climates, research was conducted on 17 furs and shearlings by this Bureau in cooperation with the Bureau of Animal Industry, U. S. Department of Agriculture, and the Fish and Wildlife Service, U. S. Department of Interior. For comparative purposes, 19 selected fabrics were also given similar study. The data furnished to the Army covered such points as air permeability in furs and fabrics, weight per square yard, compressibility, resilience, and the amount of water they could absorb, as well as how much water vapor could permeate them. The two latter properties are closely related to the comfort of clothing and sleeping bags used by troops exposed to driving rain, sleet, and snow. Since the basic information desired has now been furnished to the Quartermaster General's Office, the project is being closed, and other work on wool fabrics intensified.

Housing and household equipment investigations: For the past two years work in this field has been concentrated chiefly on equipment problems related to home food preservation -- dehydration, canning, and freezing. The work has been closely related to that of the Foods and Nutrition Investigations and progress and current programs relating to food equipment have been described under that head.

In view of the great development expected as soon as the war is over in remodeling and building rural homes, work in housing is being resumed. Studies are being undertaken to provide information on a regional basis as to the housing needs and preferences of rural homemakers, in cooperation with research agencies in the States. In addition, laboratory work on the design of important pieces of household equipment in relation to its use and placement will be undertaken. Both of these studies are urgently needed as background information in developing the functional requirements of farm and rural homes.

Home economics information:

Information for the home front: Supplying information to the public by printed bulletin, press, radio, and picture, has again been the

aim of the information services. As fast as results became available from the Bureau's research, or authoritative compilations of scientific findings could be made, these facts were put into layman's language and released for use. Some of this information feeds directly into home front programs organized by the Office of War Information to coordinate the efforts of Government agencies, educational organizations, and advertising and commercial interests, and to provide the public with well-rounded, authentic information on subjects vital to civilian welfare.

During the past year, the Bureau participated actively in three such programs -- nutrition, food conservation, and use of temporary food abundances -- and served as manager for still another, home food preservation. Besides preparing special materials on these subjects for distribution through State and local nutrition committees, schools, and extension groups, factual material was furnished to radio, magazine, and advertising copy writers. The Bureau also prepared technical papers and interpretative articles for inclusion in research and professional journals.

Totals for the year January 1, 1944, to December 31, 1944, are as follows: Published and in press 20 bulletins, 20 processed publications, 27 scientific papers, 66 articles for magazines and press; 87 radio broadcasts on national networks.

The comments of people using this material in their homes, and the steadily mounting volume of requests for it, indicate that citizens of the United States consider such services, based on research conducted in the public interest, to be part of the American way of helping people to achieve a more satisfactory life.

(b) Special Research Fund, Department of Agriculture
(Allotment to Bureau of Human Nutrition and Home Economics)

This budget schedule covers obligations under an allotment for special researches in nutrition.

(c) Exportation and Domestic Consumption of Agricultural Commodities
(Allotment to Bureau of Human Nutrition and Home Economics)

This budget schedule covers obligations under an allotment for a study of the utilization of agricultural commodities.

(d) Working Funds (Bureau of Human Nutrition and Home Economics)

This budget schedule covers obligations under an advance pursuant to Section 601 of the Economy Act of June 30, 1932, for investigations in food compression and in the packaging of dehydrated compressed food products.

STATEMENT OF OBLIGATIONS UNDER SUPPLEMENTAL FUNDS
(1944 and 1945 figures include overtime costs)

Item	Obligations, 1944	Obligations, 1945	Estimated obligations, 1946
<u>Special Research Fund: For special researches in nutrition</u>	\$47,623	\$52,755	\$44,658
<u>Exportation and Domestic Consumption of Agricultural Commodities: For a study of the utilization of agricultural commodities</u>	42,576	19,460	16,356
<u>Working Funds (Bureau of Human Nutrition and Home Economics): For investigations in food compression and in the packaging of dehydrated compressed food products (Advance from War Production Board)</u>	6,651	1,389	- -
Total, obligations under supplemental funds	96,850	73,604	61,014

PENALTY MAIL
Section 2, Public Law 364, 78th Congress
(Allotment to Bureau of Human Nutrition
and Home Economics)

	<u>Category 1</u>	<u>Category 2</u>	<u>Total</u>
1945	\$80	\$1,024	\$1,104
1946	120	1,545	1,665
Change	+40	+521	+561

Category 1 consists of bulletins, leaflets, and other technical publications describing the results of the research work of the Bureau on problems of family living, nutrition, rural housing, etc., and which are distributed at the direct request of schools, universities, institutions, women's organizations, clubs, private citizens, etc.

Category 2 consists of administrative correspondence and general business operational mailings necessary for the functioning of the Bureau. There is also included in this category considerable correspondence with State Colleges and Universities which are co-operating with the Bureau in its program.

The increase of \$561 for 1946 will be needed for additional operational mailings and dissemination of information on the research of the Bureau, resulting from work for which increases are provided in the Budget as follows: (1) An increase of \$75,000 to study consumption levels of farm families and their adjustments to different incomes; and (2) An increase of \$52,650 to develop basic information on functional requirements of farm and rural dwellings.

BELTSVILLE RESEARCH CENTER

Appropriation Act, 1945	\$130,760
Proposed transfer in the 1946 estimates to "Salaries and expenses, Office of Administrator, Agricultural Research Administration"	<u>-130,760</u>
Total available, 1945	- -
Budget estimate, 1946	<u><u>- -</u></u>

Inasmuch as the work done under this item covers service functions affecting all bureaus of the Agricultural Research Administration, it is proposed to merge this item in the 1946 estimates with the Office of Administrator, Agricultural Research Administration.

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